2020-03

Online discussion platforms for effective collaborative learning in higher learning institutions in Tanzania

John, Linus

NM-AIST

ONLINE DISCUSSION PLATFORMS FOR EFFECTIVE COLLABORATIVE LEARNING IN HIGHER LEARNING INSTITUTIONS IN TANZANIA

Linus John

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Master's in Information and Communication Science and Engineering of the Nelson Mandela African Institution of Science and Technology

Arusha, Tanzania

March, 2020

ABSTRACT

The implementation of the 2030 vision to provide a 12-years free primary and secondary education and higher education loan scheme offered by the government will increase students' enrolment in higher learning institutions. Nonetheless, higher education system profoundly depends on fixed lecture theatres–these and insufficient public discussion squares are among the challenges faced by Tanzanian higher education. In response, higher learning institutions have introduced cement seats in universities' environment; however, they serve as learning squares in arid seasons and before odd hours. Additionally, they have introduced information and communication technology solutions like learning management systems; nonetheless, these have ended being used as traditional repositories and appear not to tailor in the direction of the technology used by students.

This study mainly aimed to develop online discussion platform for enhancing effective collaborative learning for students in higher learning institutions. It used a mixed-method research design to collect data from 96 respondents from five higher learning institutions in Arusha region. Analysis using Chi-square statistical test indicated that residence was not among the factors contributed to the recommendation of the online discussion platform.

Furthermore, the platform was designed and implemented using scram agile software development methodology and Laravel Pre-processor framework. It was tested and met specified requirements.

Finally, education stakeholders, the Tanzania Commission for Universities and higher learning institutions should work on these findings and should adapt and use the online discussion platform to sustain the challenges of small number of staff and insufficient public discussion areas in higher learning institutions in Tanzania.

DECLARATION

I, **Linus John,** hereby declare to the Senate of the Nelson Mandela African Institution of Science and Technology that this dissertation is my own original work and that it has neither been submitted nor being concurrently submitted for similar or any degree award in any other institution.

Linus John _____ _____

Name and Signature of Candidate **Date**

The above declaration is confirmed by

Dr. Anael E. Sam _____ _____

Name and Signature of Supervisor **Date**

COPYRIGHT

CERTIFICATION

The undersigned certifies that has read and found the dissertation acceptable by the Nelson Mandela African Institution of Science and Technology.

Dr. Anael E. Sam _____ _____

Name and Signature of Supervisor **Date**

ACKNOWLEDGEMENT

Principally, I would like to thank God, the Almighty for bestowing me with wisdom, courage peace of mind as well as good health until I am thru with this study endeavour.

I with honour extend my profound appreciation to my supervisor Dr. Anael E. Sam for his intense upkeep and guidance in this research. Without his supervision, it would have been too difficult to finish it. Additionally, I am very grateful to express my deepest heartfelt thanks to Dr. George Matto for the best knowledge he shared, especially during the proposal development. Likewise, I feel indebted to extend my sincere cheers to Mr. Abarani David, the Senior System Administrator at Institute of Accountancy Arusha whose constant challenges on the topic extended my understanding.

I am grateful to Dar es Salaam University College of Education (DUCE), my employer and Higher Education Students' Loans Board who sponsored my studies. In addition, I wish to extend my great appreciation to DUCE for covering the deficit amount to my research budget and her willingness to grant me a study leave permission to undertake my studies.

Moreover, my huge and innermost thanks go to all the people in my family, my wife Ms. Agnes and our beloved son, Kamili for much giving of their endless supports in terms of prayers, love as well as encouragement during this study.

Finally, this research becomes certain due to the kind livelihood of numerous individuals to whom I would wish to extend my sincere appreciation. I cannot mention all, but the individuals such as my 16 classmates, NM-AIST Community, Dr. Ndomba and others have really remarkable marks in this study–both in terms of sustenance, guidance and editing of the document, once again thank you very much.

DEDICATION

I bestow this work to my late parents and my beloved brother Mr. Moshi for their support, care and encouragement towards my achievements.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND SYMBOLS

ABCD	Automatización de Bibliotecas y Centros de Documentación
AECT	Association for Educational Communications and Technology
ATC	Arusha Technical College
BEST	Basic education statistics in Tanzania
CMS	Course Management System
DUCE	Dar es Salaam University College of Education
EdTech	Educational Technology
HESLB	Higher Education Students' Loans Board
HLI	Higher Learning Institution
HTML	HyperText Markup Language
IAA	Institute of Accountancy Arusha
ICT	Information and Communication Technology
IT	Information Technology
LMS	Learning Management System
MoEST	Ministry of Education, Science and Technology
MVC	Model View Controller
NCERT	National Council of Educational Research and Training
NM-AIST	The Nelson Mandela African Institution of Science and Technology
onlineDP	Online Discussion Platform
OUT	Open University of Tanzania
QRCA	Question Redundant Checker Algorithm
SDLC	System Development Life Cycle
SM	Social Media
SN	Social Network
SNS	Social Networking Sites
SSA	Sub-Saharan Africa
TCU	Tanzania Commission for Universities
TUMA	Tumaini University Makumira
UDSM	University of Dar es Salaam
UK	United Kingdom
UMBC	University of Maryland, Baltimore County

UML	Unified Modeling Language
UoA	University of Arusha
URT	United Republic of Tanzania
USA	United States of America
USD	United States Dollar

CHAPTER ONE

INTRODUCTION

1.1 Background of the Problem

Learning via online discussion platforms has become part and parcel of learning style in HLIs worldwide. The pace of using online platforms has been on rapid increase; this is due to the advancement of Information and Communication Technologies (ICTs), the emergence of Web 2.0 technologies such as wikis and blogs among others and ubiquitous social networking sites (SNS). Students exhibit great allegiance to constructivism as they take an active part in learning using these online platforms. Constructivism is a contemporary learning theory that emphasizes learning as an active process that deals with knowledge construction rather than knowledge acquisition and that knowledge construction is dependent on the instruction rather than the transmission of knowledge (Noor-Ul-Amin, 2013).

In this regard, technology acts as a platform that supports knowledge construction and enhances learning by allowing course instructors to engage the experiences of students in the learning process. This further arouses independent learning enquiry, motivation, innovation, collaboration, improving communication skills, building self-confidence and increase problem-solving skills.

In the final analysis, all these attributes equip students to fit into the 21st century and future workplace prerequisites as well as they make them enthusiastic with the connectivism learning theory (Mtebe & Raphael, 2017; Murgor, 2015; Noor-Ul-Amin, 2013; Romero, López, Luna & Ventura, 2013). Connectivism learning theory refers to the digital age learning theory that emphasizes the role and significances of peoples' networks and their connections virtual communities as preeminent to the learning process (Neill, 2009; Siemens, 2005).

The ICTs have evolved within a short slice of time with an express pace of emergence of new and powerful ICT products (Spector, 2013). Recently, the understanding and mastering of the ICT's basic skills and concepts are regarded as one of the core parts of education as it is for numeracy, reading and writing (Noor-Ul-Amin, 2013). The move towards the use of computing devices like computers in teaching and learning (T/L) is believed to have both revolutionized and revitalized the way education is offered in Higher Learning Institutions (HLIs) around the world. There have been noticeable technological advancements that bring

challenges to HLIs. That is, to whether they get transformed or get behind, technology emergence phobia. This certain belief in HLIs is globally reflected in the number of dollars spent per annum for use in various ICT activities (Selwyn, 2007).

Furthermore, many HLIs are incurring considerable costs for procurement of different computer infrastructures and ICT products (Mtebe & Raisamo, 2014), for instance, in the recent past, institutions have attempted to blend ICTs into all facets of face-to-face teaching and learning, so it is into the students' independent study (Selwyn, 2007). Eventually, there has been a significant ICT attention globally; this is due to the number of roles it plays in changing different sectors including that of education. In other words, technology has changed the way people learn and play in various aspects of life including homes, businesses and schools (Kozma, 2008; Spector, 2013).

The impact of ICT has been remarkable in government, business and entertainment sectors in the sense that it increases the sectors' productivity which is asserted by Paul Krugman in Edquist (2017), that, in the long run, it is more or less everything. Technology has been a key driver for productivity in all sectors since it increases the output.

For instance, the introduction of e-government in various levels of government functionalities in both developed and developing countries increases man productivity, the introduction of e-commerce in the economic sector increases the economic growth globally, makes it amount to trillion USDs. It is even more in the entertainment sector; this might eventually scale up when it comes to the sector of education, particularly in teaching and learning (Spector, 2013).

The use of new and advanced technologies in Teaching and Learning (henceforth, T/L) will open ample accessibility to T/L aids, increase collaboration, motivation, interaction, innovation et cetera. For example, the introduction of gesture-based computing increases innovation using learning materials from games (Johnson, Smith, Willis, Levine & Haywood, 2011).

The ICT in T/L enriches and deepens students' skills and understanding; it makes learning more engaging and motivating, assists the students to relate school experience to work practices and enables them to create economic viability for future work requirements (Mtebe & Raphael, 2017; Noor-Ul-Amin, 2013; Shan, 2013). Based on the role of ICT tools in educational management, teaching and learning and assessment, one can be in the position to

analyze the impact technologies have on the education sector worldwide–how the use of educational technologies will alter education in HLIs.

Universities and HLIs globally, are held responsible to produce sufficient skilled and employable talents; in this augmented task, the ICT is mentioned as a core quarter among others, the government, the academia and industry (Murgor, 2015), thus universities, as well as HLIs worldwide, have been and in fact continue to adopt and use ICT in education. The developed nations like Canada, USA, UK, New Zealand, Australia and those in Northern Europe are leading in the use of ICTs such as LMS in their HLIs; this trend so far continues to increase in China and India. However, African countries like Tanzania underscore the infancy adoption stages of ICTs in their HLIs (Lwoga, 2012; Simsek, 2011).

There are several challenges impeding this adoption and use; these include low internet penetration, lack of ICT policies for some HLIs and lack of computer stations (Murgor, 2015). Professor Bates in Simsek (2011, p. 89) asserts that the general delivery formats of online learning are yet a fully online course using LMS such as Moodle and most students require a computer and strong internet to access the contents.

Lack of universal technical standards among different phones hinders the use the mobile phones which in case of Tanzania it is a technology subscribed by the majority (Fig. 1 shows the number mobile of subscriptions). However, this is not a big challenge today due to the coming of HTML5 which has standardized browsers on mobile phones. It helps to run the learning systems as browser apps hence will make it possible to deliver the online courses mobile.

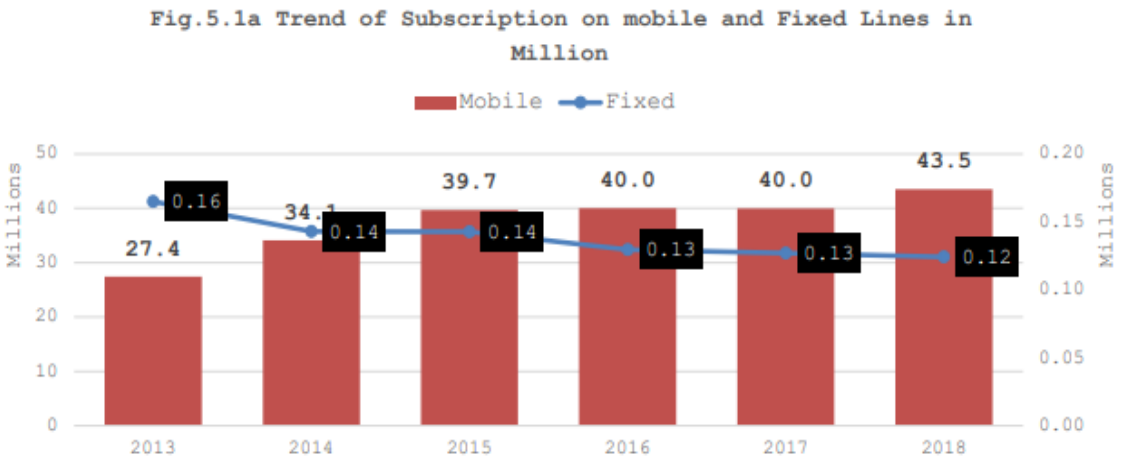


Figure 1: Mobile subscription trend in Tanzania (Tanzania Communication Regulatory Authority 2019)

Additionally, the presence of web 2.0 tools and SNS like Facebook, search engines like Google and e-portfolios will allow students to generate and save their work. This will take online learning to collaborative learning and user-generated content (Simsek, 2011).

Since the advent of SNS, there has been an increased reporting of their uses in academia. For instance, Moran, Seaman and Tinti-Kane (2011), in concurrence with Professor Bates report that approximately two-thirds of the surveyed faculty in their study had in some aspects used SNS in some class lesson and about 30% of them had posted some contents for their students to access after the regular class routine. Additionally, they report that more than 40% of the faculty once required their students to view and/ or read contents from SNS as part of a course assignment, meanwhile, 20% did assign students either to comment or post to SNS. Moreover, the faculty believed that SNS offers value to teaching.

However, despite this large number of faculty using SNS for the class lesson and their considerations towards SNS in teaching and learning, the majority of them are alarmed by the time SN requires. Correspondingly, 80% of them reported shortage of integrity from student submissions as the barrier and more than 70% of them reported the privacy concerns as the other barrier.

Furthermore, online interactions between educators and students have largely shifted from LMS to Web 2.0 services such as SN tools which allow them to socialize as well as to communicate within their confined networks (Jumaat & Tasir, 2016).

Although the interaction mode is keeping on shifting, some scholars are putting questions on the use of SNS as the tool to enhance collaborative T/L. For instance, Eger (2015), reports that there are people who denounce the use SNS in classroom T/L by saying that these are not being used for serious issues, rather are there for fun and games and cannot be used in the environments that need seriousness like in T/L processes and that many students spend much of their times on networking in SNS than they spend in serious learning.

The higher education system in Tanzania fundamentally depends on fixed lecture halls (Mtebe & Raphael, 2017). On the other side, it is reported that the enrollment is on the increase annually. For example, the BEST report shows that at the epoch of five years the number of students enrolled for higher education increased from 166 484 in 2011-12 to 189 732 in 2015-16 (URT, 2016).

Vividly, the number of students enrolling for higher education will scale up due; this is due to the fact that the government of Tanzania has increased her efforts to support education, for instance, Tanzania has the vision to provide a 12-years free primary and secondary education by 2030. To achieve this, the new 2014 version of Education and Training Policy directs the implementation of fee Basic Education–from primary to lower secondary (Mbawala, 2017; Robi, 2016); in November 2015, the Government issued circular 5 to implement the policy. It directed public bodies to make sure that secondary education is free for all children by removing any fee and contributions that were being paid by parents or guardians (Right to Education, 2016).

This is certainly going to increase the number of children enrolled for basic education and consequently raise the number of those joining the higher secondary. Finally, the possible number of students qualifying to join higher education will be high; once this is combined with students' loan scheme from HESLB, will henceforward increase the number of students in HLIs. However, this expected influx of students enrolled in HLIs, is not proportional to the existing physical facilities such as public discussion places and libraries which Istoroyekti (2016) reports being beyond fit in Tanzanian HLIs.

Some efforts have been done to respond to the challenge since then. Various HLIs have tried to blend ICT in T/L for instance, in the past decade, in 1998, despite the fearful anticipation from both academics and students. The UDSM adopted the Blackboard system as the first e-learning system (Mtebe & Raphael, 2017).

The adoption has since then continued to increase. Many institutions have been sacrificing ample resources for procurement, installation and maintenance of ICT equipment as well as other information systems so as to complement the face-to-face T/L delivery (Mtebe, 2015; Mtebe & Raisamo, 2014).

Despite the struggle, still, the majority of course instructors rely on hard copies which are difficult to share with students. Correspondingly unabated use of hard copies is tantamount to the increased running cost of education (Mtebe & Raisamo, 2014). Moreover, in many cases, HLIs in Tanzania have adopted LMSs which are less compatible with devices such as mobile phones which are owned by many Tanzanians (Mtebe & Raphael, 2017).

In addition, the adopted LMSs appear not to tailor in the direction of the technology that various students use, they mostly use SNS (Mtebe & Raphael, 2017; Wang, 2013) and thus,

they need customization. They require as well strong Internet connections which albeit the presence of SEACOM, still the Internet bandwidth in many HLIs is not sufficient (Lwoga, 2012).

Lastly, they are subjected changes in their annual subscription license fees which can cause the HLIs to switch from one LMS to another, for example, UDSM switched from Blackboard to Moodle due to annual license changes (Mtebe & Raphael, 2017); Heeks says that different information systems that get implemented in many developing countries are subjected to partial or total fail. There is a tendency to abandon old systems when the new ones are implemented (Mtebe, 2015).

1.2 Statement of the Problem

Many HLIs in Tanzania face a shortage of physical infrastructures; this forces a considerable number of students to live off-campus and conduct discussions in different places outside or under trees on campuses. Many students use the concrete cement seats referred as vimbwete in John (2015, p. 58) and benches across the University or college environs for conducting individual studies and discussions, however, these places may not be suitable in the rain seasons, or in odd hours, after day time, hence making it difficult for the students to meet for academic discussions.

In addition to the cement seats, adoption of ICT based solutions such as LMS augments the institutions' efforts to create conducive settings for learning. However, LMS and its instructional features such as discussion forums, communications and chat tools among others are either underutilized or not utilized at all in HLIs (Mtebe, 2015). In addition, course instructors and students use LMS more or less like other repositories–course instructors upload notes and files for students to download (Mtebe, 2015).

The LMS conform to the standard model used in formal education context in which a course instructor is the controller of the lesson, the LMS is the course instructor-controlled, only arrange content, gives various forums discussion, as well as online tests. To ensure the persistence of this course instructor control, a good design is emphasized. The good design here entails clearly identified learning outcome, a short set of learning tasks (often group activities like joint projects or discussion forums), continuous assessment such as test and continuous feedback from the course instructor (Simsek, 2011).

However, good design paradigm in the context of Tanzania is a paradox to majority of course instructors in HLIs; this is due to the fact that there is too little attention that is paid to developing online course contents for students and many institutions in Tanzania continue to rely on the printed materials (Mtebe & Raisamo, 2014).

Additionally, Professor Bates in Simsek (2011, p. 89) envisaged that the growth of web 2.0 like blogs, social software like as Facebook, search engines like Google, as well as e-portfolios will lead to an augmented shift from formal educational standardized content model to new course designs where content will build openly; with collaborative learning on the student-generated contents (Simsek, 2011).

Besides, Mtebe and Raphael (2017, p. 110), report that though staff have been taught to use Moodle for supporting T/L, still various students have been using a variety of social media networks. However, it should neither entail to use every technology as educational technology nor taking the advantages they contribute in achieving course goals. The focus should rather be on the considerations to the theoretical and pedagogical underpinnings, cost, technical issues (Sife, Lwoga & Sanga, 2007; Tess, 2013), as well as institutional policies. For instance, UDSM 2008 Intellectual Property Policy protects academics to share learning content meant for technology course in the public domain (Mtebe & Raphael, 2017).

This study, therefore, has been carried out to develop a more functional and user-friendly online discussion platform, a web-based application that will facilitate academic discussions amongst students in Tanzanian HLIs. The platform will ensure effective facilitation of student and/or student to course instructor interaction virtually from a varied range of devices from mobile phones to desktop computers–everywhere provided the devices are connected to the Internet.

Like other parts of the world, ICT sector in Tanzania is growing and has received much support and attention from the government, there is over 95% reduction in telecommunication costs and the increase of the Internet speed brought by the marine cables (for example by SEACOM and EASSy) and the significant efforts from the government to ensure the costs of the ICT tools are kept low in Tanzania (Mtebe & Raisamo, 2014).This has led to higher rate of ICT integration in education in Tanzania and as per 2011 about 78% of the institutions already had installed the Moodle and more than 2% Blackboard system

(Mtebe & Raisamo, 2014). This shows that the HLIs give emphasis to the importance of ICT in their operations.

1.3 Rationale of the Study

Like other parts of the world, ICT sector in Tanzania is growing rapidly and has received much support and attention from the government. For instance, there is over 95% reduction in telecommunication costs and the increase of the Internet speed brought by the marine cables (for example by SEACOM, and EASSy), significant efforts from the government to ensure the costs of the ICT tools are kept low in Tanzania (Mtebe & Raisamo, 2014) as well as higher internet penetration in Tanzania (Fig. 2). These create good environment for ICT integration in education.

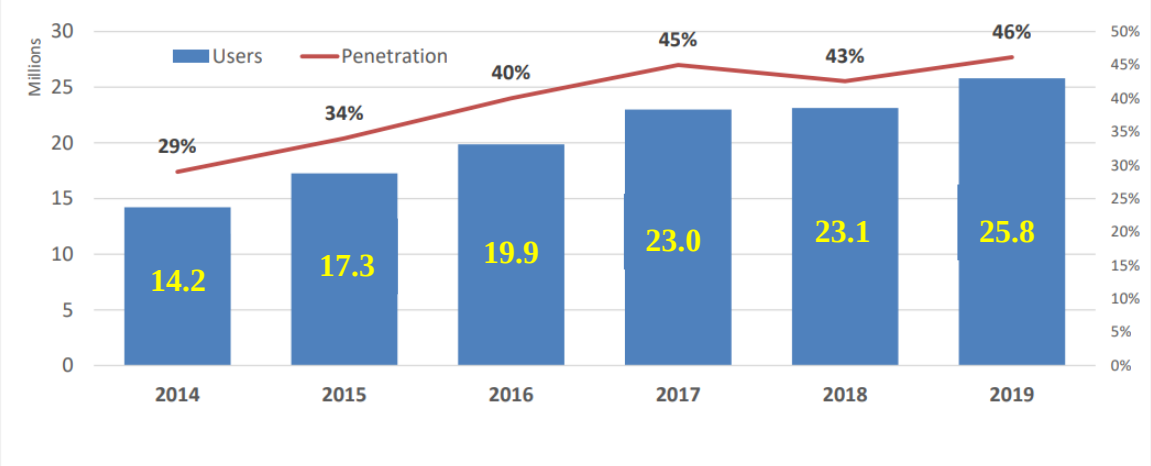


Figure 2: Internet penetration in Tanzania (Tanzania Communication Regulatory Authority 2019)

Eventually, young generation grows in the ever presence of active technologies which make them the proponent consumers of the social media services and the reliance gap between HLIs academic and management and the young students —which has left the traditional LMS to be use more or less as the repositories. Therefore, there is a need to develop academic platforms which are more of web 2.0 than conforming to the formal educational standardized content (Istoroyekti, 2016; Zdravkova, 2016).

1.4 Research Objectives

1.4.1 General Objective

The general objective of this research was to develop an online discussion platform for enhancing effective collaborative learning for students in HLIs in Tanzania.

1.4.2 Specific Objectives

(i) To collect and analyze fundamental requirements for online academic discussion platform for students in HLIs.
(ii) To design and implement the online academic discussion platform for students in HLIs.
(iii) To validate the implementation of online academic discussion platform.

1.5 Research Questions

The present study looks forward to answering the following research questions:

(i) What are the requirements for developing online educational platform?
(ii) How should the online educational platform be designed and developed to effectively capture all the identified requirements and constraints?
(iii) Did the developed online discussion platform meet the end-user requirements?

1.6 Significance of the Study

This study will benefit all citizens of Tanzania, especially those in HLIs in both public and private, higher education stakeholders: course instructors and students, educational technologists, economists and the government at large through policymaking via the responsible ministry, the MoEST.

The HLIs in Tanzania can be able to apply onlineDP to manage and assess activities of the students, meanwhile, both course instructors and students can be able to interact and collaborate in a virtual environment without constraints of geographical location and time. The study also contributes knowledge as it raises awareness about the impact of contemporary ICT products in education, T/L. Moreover, it will open new doors to different learning platforms such as Shule Direct to consider applying Semantic Information Retrieval Algorithm such as UMBC semantic similarity service (Han, Kashyap, Finin, Mayfield & Weese, 2013) rather than the use of text or keyword to control duplicates.

Finally, it ripens researchers interested in the integration of ICT into the education sector. It prepares them for undertaking other vast and astonishing research works in research adventure in the field of educational technology.

1.7 Delineation of the Study

This study used both quantitative research methods and literature review to collect data in order to obtain the requirements and used the scrum agile software methodology to develop the system.

Based on the findings, this study employed the Laravel PHP framework with Bootstrap frontend and MySQL database in the backend to develop a responsive web-based asynchronous online discussion platform. The developed platform can be accessed by all computing devices regardless of their viewport sizes.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter defines different concepts from chapter one such as educational technology, web 2.0, social media and discussion platforms. It analyzes various works of literature on the adoption and adaption of ICTs in education. Additionally, it gives an overview to group discussion, social media and academic discussion platform to mention a few. It presents the conceptual model; it shows the taxonomy of online discussion forums and the laid considerations down to choosing the hybrid discussion forum as the underlying architecture of the proposed model.

2.2 Educational Technology

2.2.1 What is Educational Technology?

Educational technology is a very comprehensive field. Thus, it is quite often to find many definitions which in some cases may seem to conflict with each other. This is attributed to the evolvement of the field of education as well as the second part of it viz. technology (Association for Educational Communications and Technology, 2004; National Council of Educational Research and Training, 2006).

Technology is a multifarious term with dynamic nature which contributes to various definitions of the term. It involves techniques, skills, methods and processes which are used in the preparation and production of goods and/or services or in the accomplishment of some particular goals.

Similarly, education has several perspectives describing education such as behavioral, constructivism and connectivism educational learning theories. This signifies that the definition of educational technology is momentary, it is not permanent.

According to Clark (2010), Educational technology can be referred to as the technological area which deals with helping e-learning, the learning and improvement of performance through creating, using and managing appropriate technological processes and resources. However, Clark recommends the definition by AECT, which defines educational technology as "*the study and ethical practice of facilitating learning and improving performance by*

creating, using and managing appropriate technological processes and resources" (AECT, 2004; Clark, 2010).

The definition of this term has to realize many contexts such as ethical dimensions, learning and improvement of students' performance using available technologies and resources in a controlled manner. Additionally, it needs to consider, the current context of education and the technology epoch.

Currently, there is a shift in education to an online environment student-centered approach (Brindley, Walti & Blaschke, 2009). Moreover, there is an omnipresent use of web 2.0 and mobile technologies for various activities; this has changed how people interact and learn.

Finally, it has to address the designing of active learning technologies that are portable in devices that are preferred by young people.

Now, the educational technology can be defined as the study that considers both ethical and legal practices in creation of an active and responsive learning environment that facilitates social, autonomous and collaborative learning

2.2.2 Educational Technology and Technology in Education

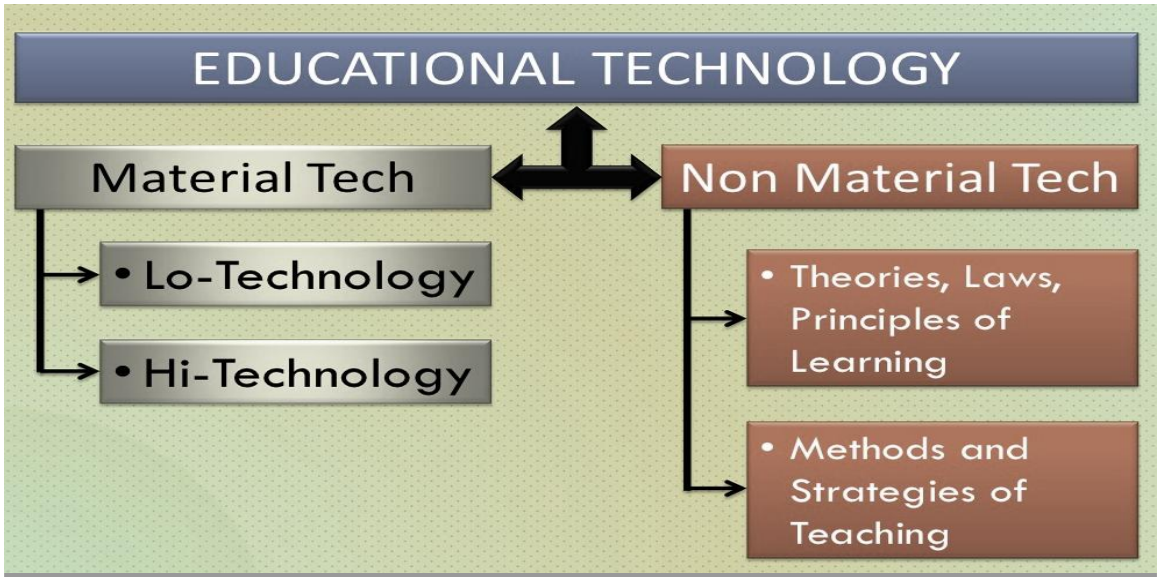


Figure 3: Components of educational technology (SlideShare, 2012)

Educational technology is occasionally used interchangeably with technology in education; however, they are not synonymous. Educational technology entails to develop, apply and evaluate systems, techniques and aids for improving the human learning process. It constitutes both material and non-material technologies. Technology in education entails the

application of devices, gizmos, instruments as well as machines in education settings (SlideShare, 2012). Figure 3 illustrates the components of educational technology.

2.2.3 Adoption and Implementation of Technology in Education

The application of various technologies in education is growing in many places around the world. The USA underscores higher usage of technologies in education. For instance, more than 90% of HLIs in the USA use LMSs; about 40% of students take a few of their classes online. Similarly, countries like the UK, Canada, New Zealand, Australia and Northern Europe register higher usage as well. Furthermore, the adoption and use of LMS rapidly grows in countries like India and China, albeit still small. This adoption is spreading in Africa as well; however, it is still immature in some countries (Lwoga, 2012; Simsek, 2011).

2.2.4 Early Technology in Education in Africa

The application of technology in education among African countries began soon after or before independence. For instance, the education system in Tanzania began to use ICT back in the 1960s (Rivers, Rivers & Hazell, 2015); during this time States were frontiers to start initiatives to implement technologies in education systems (UNESCO, 2015).

Various SSA countries used radio as their first technology in education. For instance, the ministry of education of Tanzania used radio to broadcast educational audio series to students (Rivers, Rivers & Hazell, 2015); in the 1970s, in Côte d'Ivoire, the Bouaké schools radio could train about 2,000 course instructors yearly. The year 1986 marked the beginning of the experimental schools for radio project at the institute of research and documentation in Guinea (UNESCO, 2015).

Television was another early technology in education in Africa; in countries like Senegal and Niger, in the years 1960 witnessed the educational television prior to their national televisions. In the 1971 Côte d'Ivoire was made the pilot field and followed by an immense project for teaching using television (UNESCO, 2015).

2.2.5 Challenges Facing Adoption of ICT in Education in Africa

Various African countries had adopted and used technologies in their educational systems right after decolonization (UNESCO, 2015). Nonetheless, the effort of realizing ICT in T/L in HLIs faces a variety of challenges ranging from internal factors from within the HLIs, to external factors from their environments such as national policies, plans and support.

Inside HLIs, there are some impediments that hinder the adoption and progress of ICT in education. These can be attributed to the structure and/ or culture practiced by the HLIs (Murgor, 2015). For instance, in many African universities, to develop and retain ICT personnel is the main challenge attributed to poor working environments and low salaries which later lead to brain drainage (Murgor, 2015; Rivers, Rivers & Hazell, 2015).

Additionally, sometimes the academics and other staff are reluctant to change and make off with the changing technologies; this may lead to the technological reliance mismatch between the technology academics know and trained to and that currently used by the students (John & Sam, 2018; Mtebe & Raphael, 2017; Murgor, 2015). Furthermore, the ICTs illiteracy downgrades the positive attitudes among course instructors and administrators and leads to uncertainties, fear, anxiety and stress towards the use of computer into teaching and learning (Murgor, 2015; Rivers, Rivers & Hazell, 2015).

Furthermore, there are external hindrances to the adoption and use of ICT in Africa. For instance, some countries have no national ICT policies; this leads to variations in the implantation of ICT among HLIs, thus every HLI does whatever it can do best without compelling to a central document (Murgor, 2015).

The ICT policy is very vital as Murgor (2015, p. 64), points, the occurrence of an ICT policy in a nation cannot be overemphasized as it is an extensive way to streamline ICT execution across associations– public or private. Insufficient internet bandwidth and funds are other hindrances. The HLIs in Africa still suffer from Internet problems despite the presence of optic fibre (Lwoga, 2012).

Moreover, HLIs in Africa considerably depend on the donor funds such as funds from the Development Agency (DANIDA), Swedish International Development Agency (SIDA) and Word Bank. The funds from the donors are rarely sustainable and they tend to constrain their beneficiaries to their desired outputs (Mtebe & Raphael, 2017; Murgor, 2015; Rivers, Rivers & Hazell, 2015).

2.2.6 Technology Adoption and Use in Tanzania

As far back as in the late 1960s (Rivers, Rivers & Hazell, 2015), Tanzania started using ICT in education. The 2002 ICT initiatives, increased consciousness about ICT in education and raised awareness of its importance in education. Finally, it led to the prioritization of ICT in educational planning, ICT was referred as the need that could increase and improve education

quality in several education plans like in the Secondary Education Development Plan (Rivers, Rivers & Hazell, 2015).

Moreover, until the end of 2011, there were more than 80% of institutions using different ICTs in education. About 78% had installed Moodle and more than 2% Blackboard and other technologies. For instance, technologies such as CDROMs, audiotapes, video conferencing, videotape (Mtebe & Raisamo, 2014) was already in use. The UDSM started using the Blackboard system in 1998. But it was replaced with the Moodle system due to a change in the annual license fee that amounted to more than U$1 800 per annum. Moodle system is currently used by Mzumbe University as well. However, there are still many challenges like compatibility issues, customization and institutional policy barriers to mention few (Mtebe & Raphael, 2017).

2.3 The Notion of Social Media and Social Network Site

The notion of social has been a controversial topic among researchers. Table 1: indicates what conceptions they have on the social media notion (Trottier & Christian, 2015).

Social media create a very strong rapport among students and between them and their course instructors. It gives the ability to learn under the influence of their fellows, the social learning (Rasiah, 2014). It gives privilege to users to create, send, receive and share content. It as well allows them to request and accept the friendship, comment, tag and communicate their ideas with others (Oyelere, Paliktzoglou & Suhonen, 2016).

Hence, in the connectivism context, social media provides a network for connecting people. However, to know whether a web application has become social or to what extent it is social is profoundly dependant on the theoretical know-how of the term social (Christian & Sandoval, 2014).

Table 1: Concepts associated with social media

Proponent	**Concept**
Corporate media favorite	User generated content
Henry Jenkins (media-industries-focused)	‘Convergence culture
Jay Rosen	People formerly known as the audience
Politically pervaded	Participatory media
Yochai benkler’s process-oriented	peer-production
Tim o’Reilly’s computer-programming-oriented	Web 2.0’

This study adopts Tim O'Reilly's notion, which considers social media as any computer programming oriented that has the Web 2.0 properties. Thus, any programmed software regardless of its type, that adheres to Web 2.0 is a social media.

On the other side, social networking sites enable their users to generate and share content (Alqahtani & Issa, 2018); they are types of communication technology that allow online social interactions. These include Myspace, Facebook and Twitter (Pegg, Hons, Donnell & Hons, 2018).

Ultimately, social media and social networking sites entail the application or web sites that create a network between users; therefore, this study will use social media and social networking sites interchangeably.

2.4 Web 2.0

A chief proponent of web 2.0 is O'Reilly, with the notion of web 2.0 that concentrates on the popularity of Internet usage instead of only a label for new applications in the world of technology. However, this notion did not seem interested in other scholars.

Consequently, the scholars have since then continued to redefine the term (Merchant, 2009; O'Reilly, 2005). For example, Merchant (2009: p.108) put it like this; *"Web 2.0 seems to me to be useful in drawing attention to new kinds of interactivity and describing the second wave of enthusiasm for the internet in the popular imagination"*. Additionally, Merchant (2009), points out that a range of applications that forefront the interactivity and collaboration over the collection of contents attracts the attention of educators.

Thus, the integration or use of web 2.0 tools such as Wikis, Blogs, Rich Site Summary (RSS), instant messaging, tag-based folksonomies, media sharing, social bookmarking, social and virtual networking (Lwoga, 2012; O'Reilly, 2005) in education setting may build better online communities for collaboration, sharing, learning and creativity among students and course instructors (Bohley, 2010). It is the application of the Internet to provide platforms via which network effects emerge (Blank & Reisdorf, 2012).

Therefore, web 2.0 in education is the new paradigm of internet importance which acts as the intermediary virtual platform through which a course instructor guides the engagement of students in the production of learning materials through mutual interaction and collaboration of learning parties hence leading to the lifelong learning.

2.5 Collaborative Learning in a Digital Era

Contemporarily, in this digital epoch, teaching and learning depend on various designs and categories. It depends on connectivism learning theory, the theory derived from behaviorism, cognitivism and constructivism (Al-Abri, Jamoussi, Kraiem & Al-Khanjari, 2017).

It is the digital age learning theory advocated by Stephen Downes and George Siemens and others (Neill, 2009). It follows after the impact of technology on the way people live, communicate and learn. To this effect, learning needs governing theories, description of principles and processes underlying the social perspectives should be reflective.

As a factor, connectivism learning theory emphasizes the roles and significances of peoples' networks and their connections virtual community as preeminent to the learning process (Neill, 2009; Siemens, 2005). Al-Abri, Jamoussi, Kraiem and Al-Khanjari (2017) eloquently emphasize that, in the light of this theory, learning occurs in connection formed by engagements and experiences through social media networks, Web 2.0 tools.

2.5.1 Academic Discussion Platform

Academic discussion platforms may entail the area where there are close participation and collaboration among higher learning institutions or academic stakeholders (Kovalcikova & Petrucijova, 2013).

On the other side, an online academic discussion platform uses computing devices in order to maximize collaboration and participation among academic practitioners in the so-called e-learning or web-based learning. It is the learning that offers a combined online and knowledge management through internet technology (Mahbub, 2016).

In an e-learning teaching and learning, online discussion groups or internet forums become the most popular tools for supporting communication as well as collaboration and act as the way of sharing ideas and problems, commenting on posts and obtaining feedback (Romero, López, Luna & Ventura, 2013).

The online academic discussion platform are powerful instrument that ensure the advancement in pedagogical skills: critical thinking, collaboration, reflection; they have become the focal point for e-learning in many HLIs and are effective in increasing students' grades (Abawajy & Kim, 2011; John & Sam, 2018).

2.5.2 Key Factors for Online Discussion Platform Development

Abawajy and Kim (2011), suggest the online discussion forum taxonomy that can enhance the development of effective discussion forums. This taxonomy classifies different online discussion groups based on the inclusion or exclusion of ten points in Table 2; these points assist to realize what features to consider when developing an online discussion platform.

Table 2: Taxonomy of asynchronous online discussion forums

Point	Auxiliary	Hybrid	Embedded
Participation	Optional	Mandatory	Mandatory
Instructor		Visible	Visible
Major Interaction	student-to-student	student-to-student, student-to-instructor	Student-to-student, Student-to-instructor
Participation Assessment	None	Explicitly assessment	Explicitly assessment
Course instructors Engagement	Mostly optional	Essential	Required
Message Quantity	Low	Medium	High
Topic Time-To-Live	None	Maybe	Maybe
Receiving Feedback	None/slow	Slow	
Learning	Instructor-led learning	Blending learning	student-led learning
Activity	Open, self-directed and unstructured	Single topic decided by the course instructor and semi-structure	Single topic decided by the course instructor and highly structured

Abawajy & Kim (2011)

Moreover, these scholars discussed the strengths and shortcomings of each of the classes. Finally, they accorded to classify the online discussion forums as Auxiliary which supplements the traditional face-to-face classroom learning, Hybrid in which the group becomes the main element of a face-to-face classroom and Embedded in which learning has to be whole online.

The three models of asynchronous online discussion environments are similar in some ways, for instance, they all allow users to post messages to permanent storages for others to conveniently react to them later (Abawajy & Kim, 2011).

Additionally, points in Table 2, draw distinguishing lines between these models, nonetheless, some points span more than one class. The Venn diagram in Fig. 4 indicates that no point found in one class only; each point appears in at least one class and six points represent the elements found in all the models. The hybrid class is an all-encompassing discussion forum because it is comprised of all elements necessary to be considered when preparing an online discussion platform. This study, therefore, recommends considering the hybrid discussion forum when developing a platform that supplements a traditional teaching and learning.

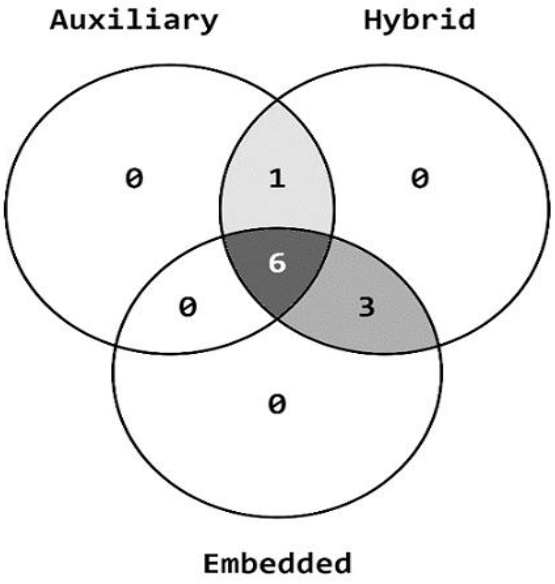


Figure 4: Relationship between asynchronous online discussion forums

2.6 Related Works and Application of Technology in HLIs

Several efforts had and continue in developing academic platforms to support T/L activities worldwide. However, many researchers emphasize carefulness when using technologies in the educational context, it is better to check and balance between the roles played by technology vis-à-vis the theoretical underpinnings governing education.

2.6.1 Sakai System

A customized Sakai platform at UNISA used for administrative functions, academic collaboration and tuition related dealings. It has about 13% active users out of the 96% of

students. Thus, UNISA mainly used it for administrative issues (Bagarukayo & Billy, 2015); it used to provide feedback and assessment. Finally, Sakai has mathematical notations and advanced features such as video conference, but it requires USD 50 and USD 500 subscription fees for the registration of individual and group, respectively.

2.6.2 Moodle System

Until 2011, 78% of HLIs had already installed Moodle (Mtebe & Raisamo, 2014). Moodle system makes the T/L materials available electronically to all students; makes students the active contributors rather than passive recipients of the materials, therefore it brings into reality the student-centered T/L approach (Mtebe & Raphael, 2017).

Initially, when the Moodle system adopted, it was only running on the computers. This, in fact, left students with no computer limited access. In response to this, in 2015 institutions like the UDSM decided to expand the Moodle system to be accessible via mobile (Mtebe & Raphael, 2017). The Mobile Moodle was downloaded, customized and configured to provide Moodle access to students through their mobile phones. The customized mobile Moodle ran onto the mobile devices and had various embedded communication tools such as e-mail, chats and discussion forums (Mtebe & Kondoro, 2016).

2.6.3 Challenges with LMS and Mitigation

Mtebe (2015), reported that LMS in many African countries are underutilized or not used at all; Wainwright (2009), as cited by Mtebe and Kondoro (2016, p. 2) said that the *"adage of if you build it, they will come is not necessarily true when it comes to LMS."* There is a relatively low number of LMS users in many HLIs in SSA (Mtebe & Kondoro, 2016), For instance, Bhalalusesa, Lukwaro and Clemence (2013), reported that only 8% of the academic staff used Moodle to communicate with students at OUT. Furthermore, course instructors and students use LMS more or less like other repositories–they upload T/L materials for students to download (Mtebe, 2015).

Moreover; Alwi, Mahir and Ismail (2014), pointed out that off-topic communication, zero communication and prolonged communications are the three common categories of online communication challenges. Thus, in this era of web 2.0, it is very substantial to integrate LMS with the social media features (Zdravkova, 2016); these features students to build very powerful rapport between students and course instructors. Moreover, they enable students to learn under the influence of their fellows in a given setting (Rasiah, 2014).

2.6.4 ABDC System

Despite the importance of a library in an academic context, it is among the challenges reported to face HLIs (Istoroyekti, 2016). HLIs like Mzumbe have used ABCD to respond to the challenges associated with the library.

ABCD is open-source web based software for modern libraries that provides a unified library management platform, encompassing all major librarian functions such as bibliographic database management, transactions, serial control and online end user searching on both local and external databases. Despite its helpfulness in managing and making the library resources available easily, still it is not an interactive discussion platform that students can use to discuss with course instructors or their fellows (Dhamdhere, 2011).

2.6.5 Edmodo

Figure 5 shows the welcome page for Edmodo; it is an SNS established in 2008; it mainly uses the micro-blogging model to facilitate informal learning beyond classrooms. It is the platform that provides means for connections, collaborations, assessment of homework, grading, sharing of contents and school notice (Oyelere, Paliktzoglou & Suhonen, 2016). Edmodo is a global education network that assists to connect all students with people and resources required to attain their academic potentials. By 2018 it had over 85 million members of 190 countries.

Edmodo has many features that make students like and accept it; additionally, it resembles other social media like Facebook, already experienced by students. It directly allows submission of files, it has a system for assigning homework, grading, giving information, as well as updating news. It allows tutors to create groups, post and share materials (Oyelere, Paliktzoglou & Suhonen, 2016; Thongmak, 2013). However, it is difficult to contextualize Edmodo at the institutional level. Moreover, HLIs whose students can use Edmodo are not the owners, so no guarantee of the information privacy for HLI.

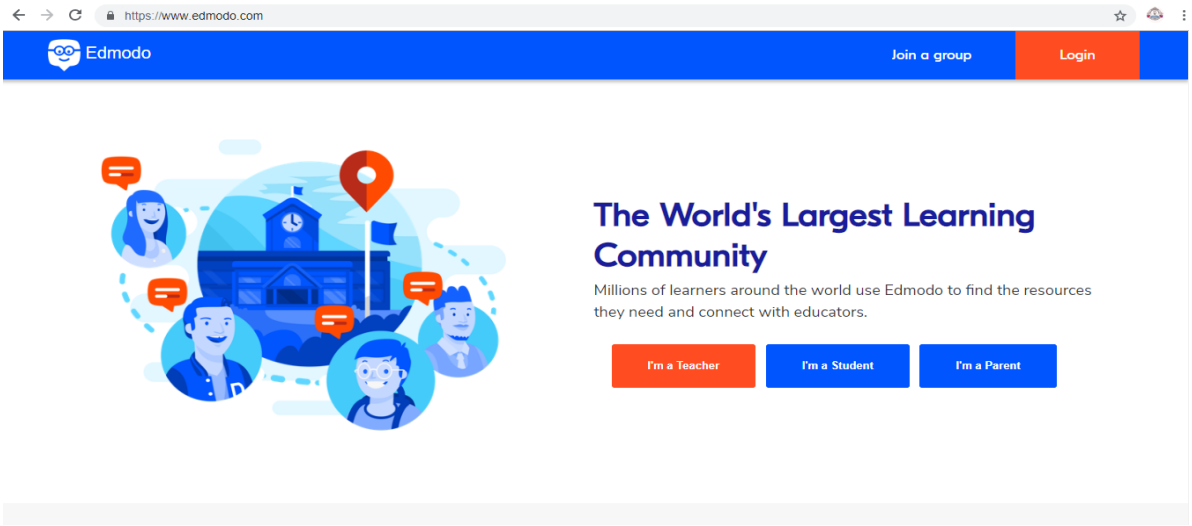


Figure 5: Edmodo discussion platform home web page

2.6.6 ShuleDirect Web Application

Figure 6 shows the welcome page for ShuleDirect; this is a website based in Tanzania. It contains the learning materials which conform to Tanzanian secondary schools' syllabi. It allows students to test themselves via quizzes and past papers; it has a group discussion functionality that enables users to create groups and discuss.

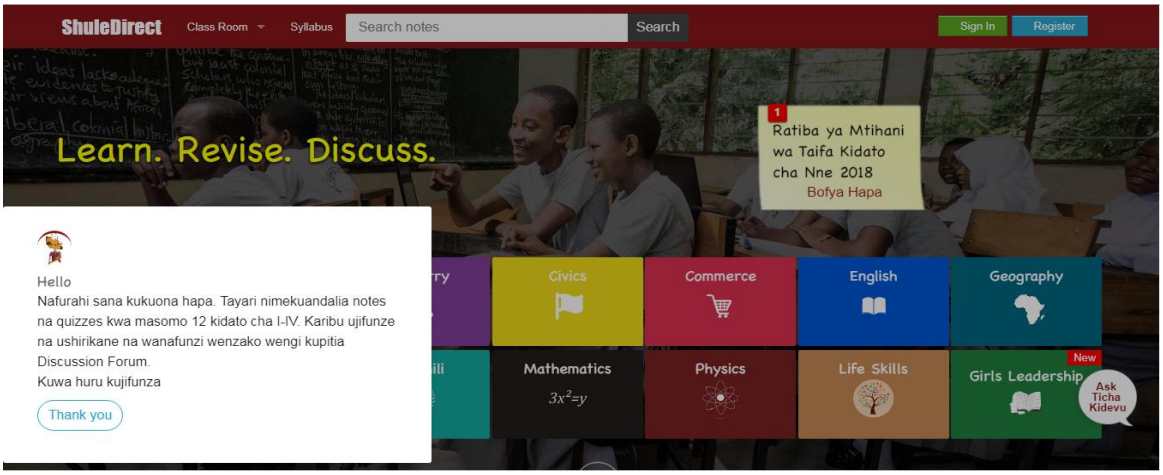


Figure 6: ShuleDirect home welcome page

Additionally, it gives access to various learning resources in terms of videos and supplementary books. Moreover, it gives access to extra-curricular subjects (Life skills and Girls Leadership).

On the other side, ShuleDirect does not allow the formatting of complex formulae. Additionally, its content moderation process is dubious. For instance, immediately after posting the post, it becomes visible to others. Moreover, there is less consideration given to

the elimination of duplicated content. ShuleDirect solely disallows duplication of title, but not main contents.

It lacks a direct functionality to invite a third party to mitigate disagreement matters that may happen from the discussion. Furthermore, it mixes entertainment and academic discussions; this can distract the attention of students. Finally, it is mainly for secondary education level syllabi, not for HLIs curricula.

2.7 Conceptual Framework

Figure 7 presents the proposed online collaborative discussion model for HLI in Tanzania. It indicates that for the collaborative online discussion to be effective and attain a particular learning outcome, it requires close monitoring of activities from the participating entities. The entities must, therefore, communicate in a controlled system; this will make them communicate, discuss and exchange material following copyright and intellectual property rights requirements.

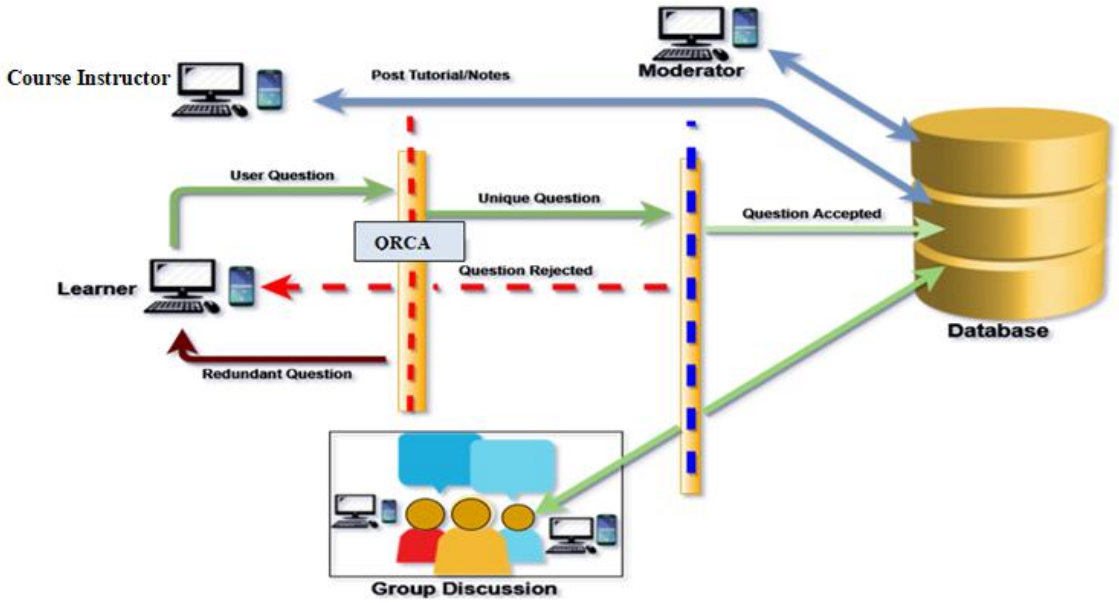


Figure 7: Proposed model for effective online discussion platform

According to the model, the course instructor makes sure that participants only share pedagogical information which cannot misdirect others. Similarly, the moderator makes sure that screens information users post against institutional and legal information policy requirements.

On the other side, the QRCA filter checks for information duplications and resolves them. Moreover, the only information that passes filtration criteria and gets the moderator's approval will reach the users. Finally, the model will allow communicating entities collaboratively discuss asynchronously and it will store each event in the database for later references.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Introduction

This chapter discusses the rational choices of various tangible and non-tangible materials and methods used to achieve this research. This chapter has three main sections; the research design section presenting various methods, techniques and methods applied in answering the first research question which asked: What are the requirements for developing the online educational platform? The second section presents how various techniques were integrated to answer the second and third research questions which asked: how should the online educational platform be designed and developed to effectively capture all the identified requirements and constraints? Did the developed online discussion platform meet the end-users requirements? The third section indicates ethical considerations followed in this study.

3.2 Research Design

To accomplish a research study, it required planning for several methods and techniques; it needs logical integration of various research components to efficiently handle the problem under study (Saunders, Lewis & Thornhill, 2016). Research design can be referred to as a generic plan on how to go about answering the research question(s). It contains clearly articulated objectives from the research question(s); it identifies sources of data, the proposition on how to collect and analyze data.

Finally, it has to involve issues concerning ethical considerations as well as study constraints (Saunders, Lewis & Thornhill, 2016). Therefore, a successful and efficacy planning of this design acts as a bridle which ensures full control of the study to its successful endpoint(s).

3.2.1 Research Design Motivation

Research design is a very vital portion of any research activity. It economizes the research activity by making sure that only essential data get collected as per the research problem. It hence becomes of assistance to a researcher in carrying the research systematically and timely (Relivingmbadays, 2013).

According to Saunders, Lewis and Thornhill (2016), using a mix of research methods in any single phase of data collection as in data analysis; allows for both sets of results to be interpreted together. This provides very clear and more comprehensive answers to the

research question(s), in a shorter time slice and very practical manner. Thus this study applied quantitative and qualitative methods, the mixed methods (MM) design.

Researchers suggest several sets of mixed methods designs with some purposes derived by the research question(s) (Schoonenboom & Johnson, 2017); as well, the ability of the researcher to creatively prepare and combine the MM design components (quantitative and qualitative strands) to answer the research question(s) determines the MM research features (Teddlie & Yu, 2007).

3.2.2 Mixed Research Design Adaptation

At this stance, this research essentially sought to answer the question of what are the fundamental requirements for developing a successful online discussion platform. It was motivated to investigate the impeding factors and challenges the students face during the discussion. It, therefore, adopted a deductive concurrent design from (Schoonenboom & Johnson, 2017, p. 119); wherein the quantitative element is the core part that gets supplemented by a qualitative element. The questionnaire used in this research (Appendix 7) perfectly reflected the adopted research design; it has close-ended and open-ended questions for objective answers and subjective answers, respectively.

3.2.3 Study Area

This research targeted HLIs in Tanzania; nevertheless, it included only those found in Arusha region; this convergence considered the suitableness of the case study method in information system researches. The case study method helps to investigate contemporary issues (Myers & Avison, 2002), the awareness and challenges students face when using various ICTs. Other factors were time, budget constraints and the number of HLIs found in Arusha; this region is the second region with a large number of HLIs right after Dar es Salaam (Fig. 8). Moreover, the HLIs in Tanzania almost operate in the same manner under the TCU. Finally, the research host institution (the NM-AIST) is in the region.

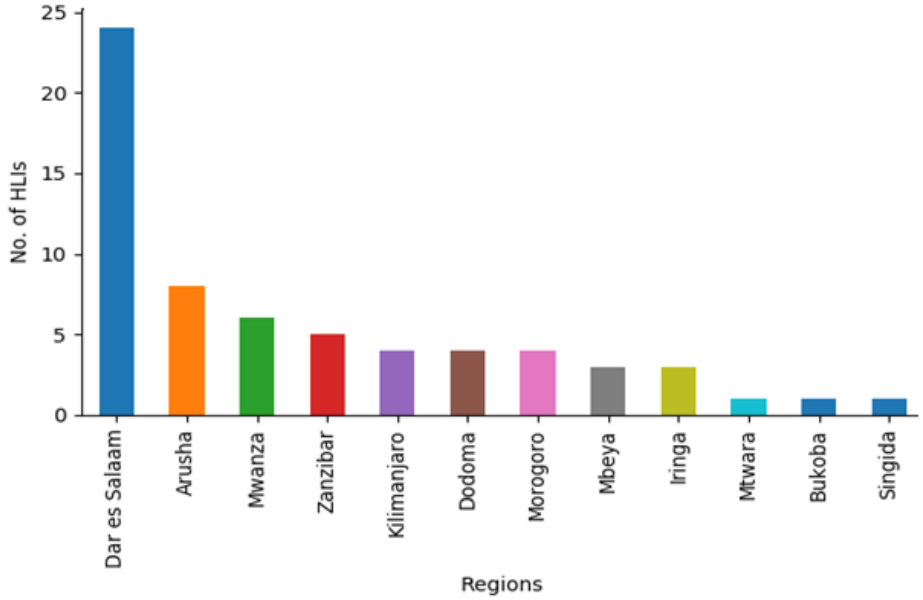


Figure 8: Number of HLIs eligible to offer degrees in Tanzania (Tanzania Commission for Universities, 2016, 2018)

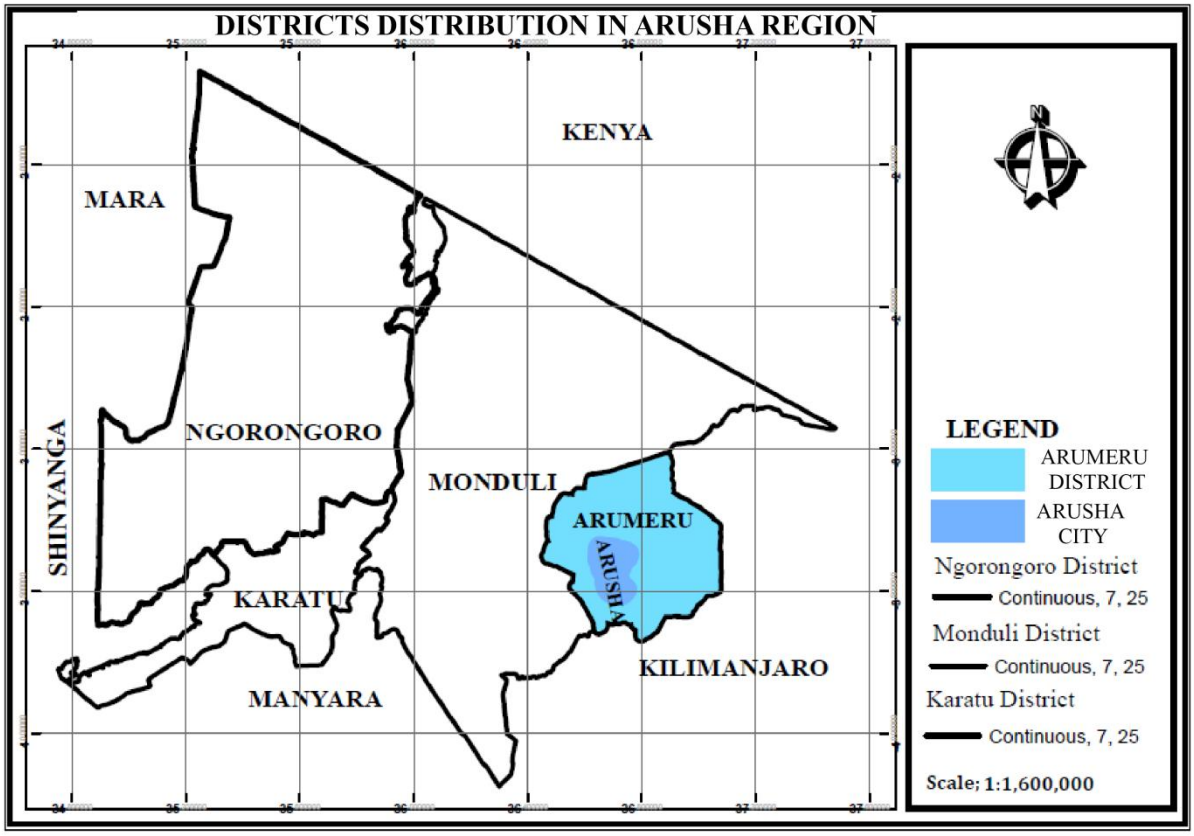


Figure 9: A map of Arusha region showing the boundaries (Tanzania National Bureau of Statistics, 2018)

Figure 9 shows the boundaries of Arusha region, Arusha region: is geographically situated in the north-eastern corner of Tanzania; Arusha city is a regional capital and an important center for executive and continental activities (Development Institute Overseas, 2016). Arusha region borders with the Kilimanjaro region in the east. The region borders with the Manyara region in the southern part. In the western part, it shares a border with two regions of Shinyanga and Mara and in the northern part, it borders with the Republic of Kenya.

3.2.4 Population, Sample and Sampling Technique

(i) Population

Refer to an aggregate of individuals who share similar characteristics. For instance, all book authors would make a population of authors. It is the whole set of strands that can produce a sample; it can include other nonhuman entities such as schools, restaurants (Creswell, 2012; Saunders, Lewis & Thornhill, 2016). The population in this research involved two entities: HLIs and higher education students both from Tanzania.

(ii) Target population

This may refer to the sampling frame with a collection of various entities classified under some general characteristics which a researcher can identify and study; from this, a sample is chosen (Creswell, 2012). Collecting data or studying the whole population can better than doing it from its part, a sample (Saunders, Lewis & Thornhill, 2016); however, for some populations, it can be impractical, time-consuming and not cost-effective. Thus, the small budget allocated and time required for finishing this research, it was feasible and practical to target only some HLIs and students from Arusha region.

(iii) Sample

It is also known as a case study; this is a subset of any targeted population (Banerjee & Chaudhury, 2010; Creswell, 2012).

(iv) Sampling Techniques

Sampling is the process of considering a subset of the population against itself (Etikan, Alkassim & Abubakar, 2016). There are two main sampling techniques: probability and non-probability sampling. However, to use one or both depends on the research design; Teddlie and Yu (2007, p. 85), pointed out that "*The strand of a research design is an important*

construct that we use when describing MM sampling procedures." Therefore, since this study adapted the mixed method design it was necessary as well to use the mixed methods sampling approach. This study used the concurrent mixed methods sampling approach; hence it combined both main sampling techniques.

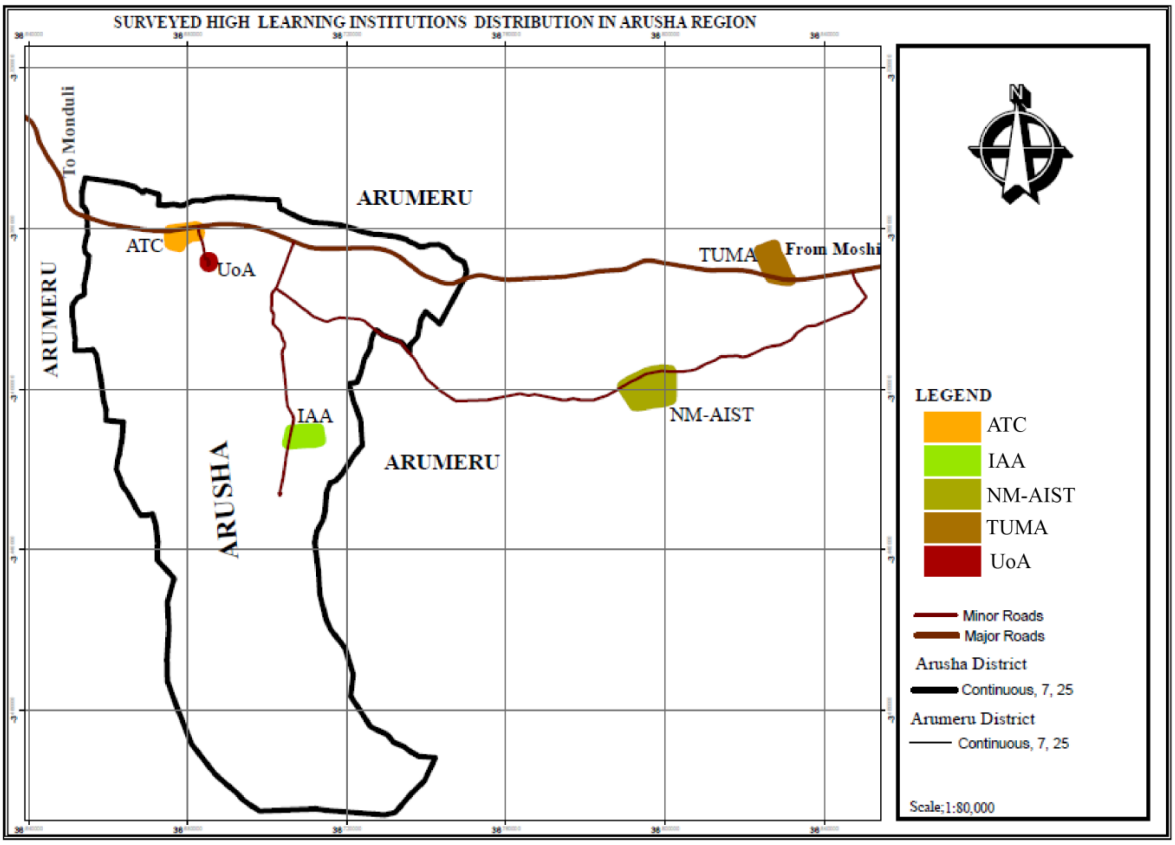


Figure 10: A map showing the distribution of surveyed HLIs (Tanzania National Bureau of Statistics, 2018)

***Non-probability*:** This is a sampling technique that does not necessitate knowing the probability of each population subset. It includes subjective judgments when selecting samples (Creswell, 2012; Saunders, Lewis & Thornhill, 2016). This approach was applied to purposively choose five HLIs: the ATC, IAA, NM-AIST TUMA and UoA (Abrahim, Mir, Suhara & Sato, 2017). Figure 10 is the map that shows the distribution of these HLIs in Arusha region.

***Probability*:** This approach ensures that the chance of every target population element to be chosen as a part of the sample is known (Creswell, 2012; Saunders, Lewis & Thornhill, 2016). This research used the technique to obtain the sample of students albeit it was somewhat very difficult to know the exact size of the target population, the students in HLIs

in Arusha; which Smith (2013), denoted as a common challenge and proposes to use a formula (3.1) to annul it.

(v) Sample Size Computation

For the sample size calculation, this study used a confidence level (CL) of 90%, an estimated proportion of 45% and the confidence interval (CI) of 45%±8%. These values were selected subjectively because the size of the target population was unknown before. Thus it was very difficult to certain to the higher extents for the unknown population size.

The value for CL ranges from 0% to 100%, it tells how certain can a researcher be; however, many fields and other software use 95% as the default value for CL; this value has its roots as back as to the work of an "*English statistician and world-class evolutionary biologist Sir Ronald Aylmer Fisher,"* which set it to 5% and no less or more. The modern researchers prefer referring to it "*as a level of .05, a 5 percent probability that a research result does not indicate a real effect but rather comes from some random source*" (Kelley, 2016).

$$n = \frac{\left(Z_{\frac{\alpha}{2}}\right)^2 \times pq}{E^2} \qquad (3.1)$$

Where;

n=The number of expected sample

Z=Z-score

p=Population Proportion

q=p-1

E=Confidence Interval(CI) or Margin Error

α=Confidence level

Thus; Z-score for 90%

100%-90%=10%=0.1

Hence, $Z_{\frac{\alpha}{2}}=0.05$

$$Z = 1.64485,$$

Now, substituting values in equation(3.1),

$$n = \frac{(1.64485)^2 \times (.45)(1 - 0.45)}{0.08^2} = 104.6279768 \approx 105$$

So, the sample size required to be at least 105 respondents.

3.2.5 Data Collection

Data are values obtained from quantitative or qualitative variables; they act as the fundamental entities for any research study (Yin, 2016). Therefore, proper collection and analysis of data can be regarded as drivers towards the aimed destination and may assist to obtain the desired results which can answer the research question(s), leading to the attainment of the research aim and objectives.

There are various sources of data such as interviews, questionnaires, document sources, participants observations (fieldwork) and observations, researcher's impression and reaction, video, texts and Archival Records (Cassell, Cunliffe & Grandy, 2018; Myers & Avison, 2002; Yin, 2016). This research mainly used Documentary Sources and Questionnaires to collect data.

(i) Documentary Sources

To achieve a documentary review, this study used journal articles, e-books, reports and Internet sources. The aim was to get an exhaustive understanding of the topic from background information gathering to the high-level requirement complements. For instance, the work by Abawajy and Kim (2011) pioneered the decision to choose the type of online discussion platform to be developed. Today, the documentary sources are very potential sources of data and information in any research they are relatively inexpensive to access, rich in the background information and unobtrusive. Additionally, they provide a surreptitious look at those programs which are not observable directly. Finally, they may bring up all other issues which might not have been noted by other data collection means (Centers for Disease Control and Prevention, 2009).

(ii) Questionnaire Use and Administration

Collection of data for this study used questionnaires; the students were the key informants. The study used questionnaires to include a lot of questions, also they help to examine the

variability of the phenomena and find the relationships between given variables (Saunders, Lewis & Thornhill, 2016).

Questionnaire Administration: The questionnaire distribution was conducted physically to the randomly selected students and others sent to selected students emails via Google form link. The questionnaires served dual purposes; they helped to collect quantitative and qualitative data using the closed-ended and open-ended questions, respectively.

3.2.6 Data Analysis

The analysis of data followed some processes such as data entry and coding. Nevertheless, Internet questionnaires automatically receive and store data in a file in some predefined forms and formats that are compatible with analysis software (Saunders, Lewis & Thornhill, 2016). But, this depends on the study and questionnaire design, the responses and the analysis software. Thus, it may as well need to be processed to meet the requirements.

The hard copy responses questionnaires entered using the Google form preview option; this ensured that there was only one dataset containing the responses from Google forms and those collected physically, it additionally made the data entry task easier. Afterward, the Microsoft Excel (.xlsx) dataset file was downloaded.

3.2.7 Data Processing and Coding

The downloaded dataset contained data from both quantitative and qualitative variables; this necessitated the extraction of quantitative variables from the dataset, it required to identify the multiple response variables before beginning coding. Later, the excel function in (Appendix 4) was used to extract the values from variables with multiple responses to new excel columns. Moreover, coding had to begin in accordance to the codebook (Appendix 6).

However, analysis did not immediately start because sometimes data may need necessary preprocessing before analysis because usually, data may be inconsistent, incomplete as well as noisy. It is somewhat difficult to identify all data defects in CSV format as it would require cross-checking of the entire document. Then, in this study the used Python programming for data analysis. Python allows for clear notations and visibility of some data defects. To achieve this, the codes (Appendix 11) for analysis were written on the Jupyter Notebook.

The CSV file was imported using the pandas Python Library read_csv() function, followed by the cleaning data to obtain the precise data and then the analysis conducted. The pandas Library easily indicates some data defects such as missing data, the NaN which result in inconsistencies and incompleteness of data during analysis. To deal with such defects and others, the study applied the data cleaning approach in which the replacement of missing attributes conducted using the attribute mean or majority nominal value computed using the means and modes respectively, followed by value replacement conducted using the pandas function fillna(). For plotting, the matiplotlib library was used. The statistics library was applied to compute the mode of the attributes before the replacement. The numpy library utilized for some computations and array manipulations for data visualization.

Analysis of qualitative variables followed another route; the MAX (Qualitative Data Analysis), MAXQDA 2018.1 used to run all qualitative analysis. Here dataset file imported without separating the variables (importation summary in Appendix 5), five themes corresponding to the questions asked in qualitative variables. Other codes came from the responses given by the respondents.

The questionnaire sought to collect the information on the recommendation of the online discussion platform as an effective collaborative. Due to such a reason, this study performed the Chi-square statistical test to assess if any factors would contribute to the recommendation of the online discussion platform. Additionally, it used frequencies, tables and graphs and succeeded by the interpretations of various findings and drawing of various inferences accordingly.

3.3 System Development Approach

The SDLC refers to the conceptual model that describes different phases involved in an information system development endeavor. It includes the activities of planning, analysis, design and implementation (Alan, Wixom & Tegarden, 2015). It is a phased approach that guides the use of specific analyst and user activities cycles to develop the best systems (Kendall & Kendall, 2011).

This study mainly adapted the SDLC in the route indicated by the red–arrowed in Fig. 11. There are several reasons led to the adaptation, these include requirements of the system that were not initially known in advance and expected to change underway, the development of onlineDP used the Laravel PHP framework. Laravel is an MVC framework written in PHP

programming language used for web–development (John & Sam, 2018); supports the Object-oriented-programming paradigm and uses the controller mapper to separate the presentation layer (what a user requests and gets) from the logic layer (what the system does in return) (Sinha, 2017).

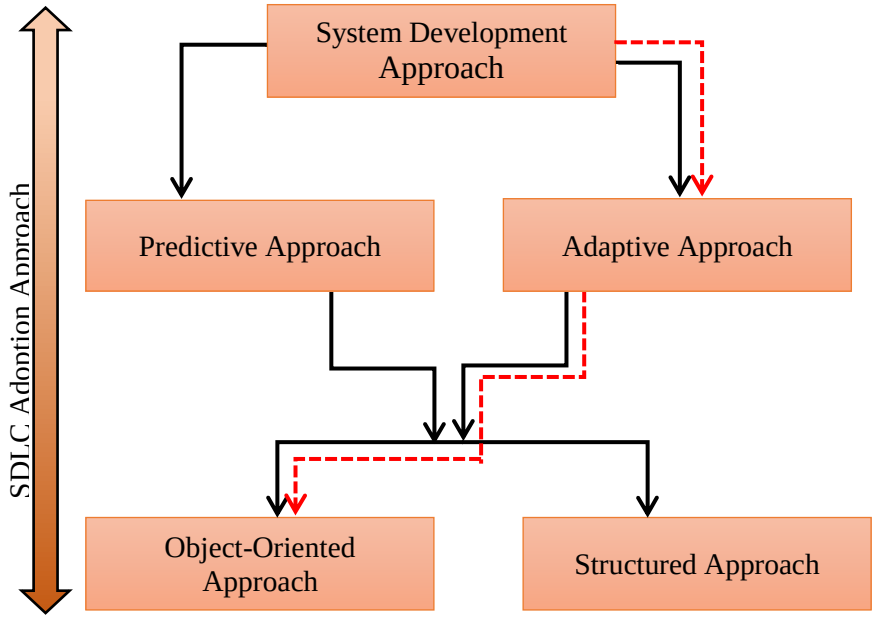


Figure 11: System development life cycle adaptation process

3.3.1 System Analysis, Design and Implementation

Independent of which approach to SDLC one takes or the methodology used to accomplish the project, the core activities of the SDLC are very crucial. However, these activities are not always executed sequentially (Fig. 12). Sometimes they are conducted iteratively; this would result in a series of the mini-projects depicting small parts of the application (Satzinger, Jackson & Burd, 2012).

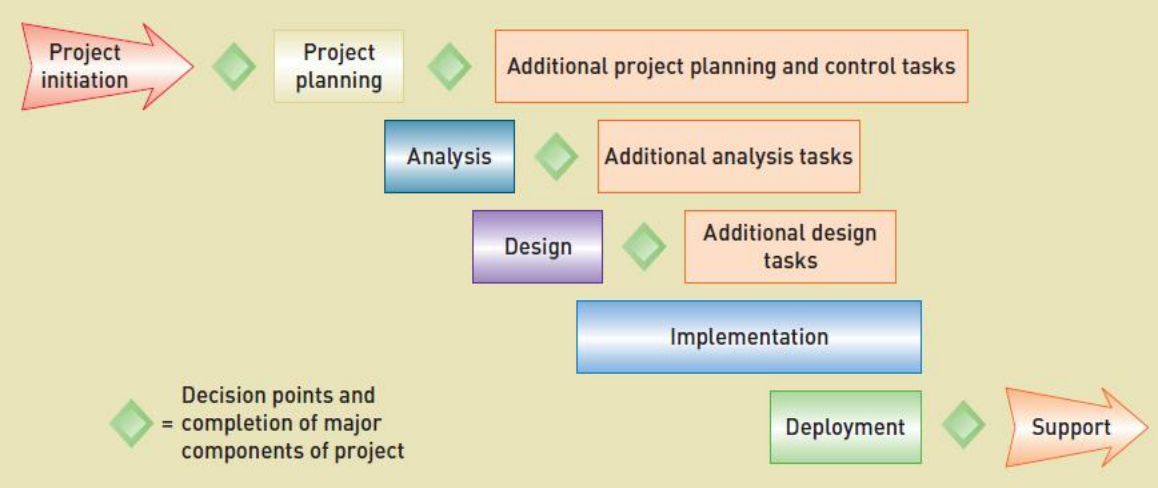


Figure 12: Overlap of system development phases (Satzinger, Jackson & Burd, 2012, p. 230)

(i) System Analysis

This is the SDLC activity that sets the tone to building the system; it answers the w-w-w-w question: Who will use the system, What is it going to serve, Where as well as When. This helped to analyze the onlineDP; it was analyzed as the system that will offer a collaborative discussion environment for students in HLIs in Tanzania. However, to achieve the analysis needs to perform set of activities such as analysis strategy and requirement gathering.

The analysis strategy acts as the guide to the team's effort; often includes the analysis of current system, associated problems and what are the ways towards designing new system (Alan, Wixom & Tegarden, 2015). Through the literature review this study identified several weaknesses of different LMS such that are occasionally used by course instructors and students as repositories. Additionally, when students use SNS for discussion, they find themselves spending much of their time in doing social networking than learning. Moreover, this study found that the hybrid asynchronous discussion forum to be the best guideline when designing and developing new system.

This ended with the system proposal that comprised of analysis, system conceptual framework; it got approved by the NM-AIST as per approval letter (Appendix 1).

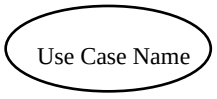
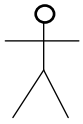
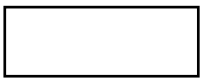
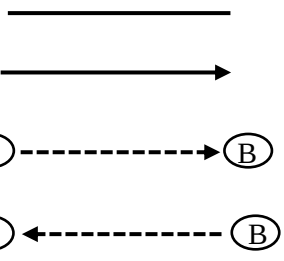
After approval, gathering of system and stakeholders' information and the requirements began. Requirements–all the activities that a system will be developed to perform and the underlying constraints that it must meet for it to work properly. They include functional requirements (the services the system offers) and non-functional requirements (its

characteristics) (Alan, Wixom & Tegarden, 2015; Sommerville, 2011). The collection of these requirements involved primary stakeholders from HLIs. These requirements were modeled to the new system model.

The modeling proceeded by the prioritization of requirements; this helps to abide to the resource scarcity nature. To achieve this step, this study used use case, sequence and class diagrams (Kendall & Kendall, 2011; Satzinger, Jackson & Burd, 2012).

Use case diagram: The use case diagram is the UML model which graphically represents the use cases and their relationship with users. Use case refers to the action that the system performs often after a user triggers an event; it may be external, temporary or state events. To identify various use cases for onlineDP this study used the CRUD (Create, Read/ Report, Update and Delete) technique since the onlineDP is of more or less of that nature, it involves creating, retrieving, updating and/ or deleting some of them.

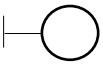
Table 3: Various notations used in use case diagram

Item	Description	Notation
Use case	The action that the system performs	An oval with the name inside 
Actor	A person or a device receiving a service from an application	
Automation boundary	A border between the computerized section of the application and the application's operator	Rectangle 
Relationships	• *Communication* (Connects actor to a use case) • *Generalization*(The arrow points to the general UML thing) • *Include*-Pointing from common use case (A) to the inclusive use case (B) • *Extend* points from the child use case (B) to the parent use case (A)	

Sequence Diagram: In a UML modeling language sequence and communication diagrams are used for showing the interaction between objects (Burgueño, Vallecillo & Gogolla, 2018). However, this study used the sequence diagram to give much emphasis on how the system

works when users interact with it rather than the users' interaction which is ultimately provided by the communication diagram.

Table 4: Various notations used in sequence diagram

Item	Description	Notation
Box	Represents the actor, class or an object instance	
Entity Element	Represents system data	
Boundary Element	Represents the boundaries of the system	
Control Element	Indicates a controlling entity or manager	
Vertical Line	Shows class or object lifeline; corresponds to time from its creation through when it gets destroyed.	
an X	An X on the bottom of each lifeline indicates when the object gets destroyed.	
Lateral bar/vertical rectangle	Shows the focus of control when the object is busy executing.	
Solid horizontal arrow	Represent synchronous calls, used when a sending class waits for some responses.	
Half (open) horizontal arrow	Is used to represent the asynchronous calls or those expect no responses	
Dashed horizontal arrow	Used to show the returns	

Athuraliya (2019)

Some refer to it as an event diagrams, timing diagrams or event scenarios; it is a kind of interaction diagram showing how various system processes operate with each other in a certain order. It shows the interaction between objects in a given system scenario. It deals with the construction of a Message Sequence Chart (Burgueño, Vallecillo & Gogolla, 2018; Sekar, Kumar & Gowtham, 2018).

A Sequence diagram can be used alongside with the class diagram to make a clear and complete realization of the use case (Kendall & Kendall, 2011). It can show how users

interact with onlineDP. Finally, it indicates the sequences of messages between classes and objects.

Class Diagram: In a UML, a class diagram is a kind of static structure used to describe the structure of the system by indicating the system's static features without any particular processing. Additionally, it indicates the nature of the relationship existing between classes, methods (or operations) and attributes. Moreover, it shows the classes that contain information (Kendall & Kendall, 2011; Sekar, Kumar & Gowtham, 2018).

In UML the class diagram can be indicated at different levels from the simplest form of just class names inside a box with a simple note of association existing to other levels which look like semantic data model, where the semantic data models are applied in designing the software database (Sommerville, 2011).

(ii) System design

This phase guides the decision about how the system to be developed will operate, it deals with hard or software, network and infrastructure. The issues relating to user interfaces, forms, files and databases are required (Satzinger, Jackson & Burd, 2012). This phase involves activities such as design strategy, architectural design and database development.

***Design strategy*:** This involves clarifying who develops the system; it is either a company or an individual programmer or outsourcing. For the case of this study all development duties except for the API which sought permission from the owners, were handled in this study

***Architecture design*:** Architectural design refer to the description of hard or software and the network infrastructure to be used, normally, the system either adds or changes the already existed infrastructure–the issues of forms and interfaces and how the user can start interacting with the system are specified (Satzinger, Jackson & Burd, 2012; Sommerville, 2011). The onlineDP uses the MVC technology and it is a web-based application built using a Laravel PHP-framework; it adopted the MVC web application architecture (Fig. 13) and users use the menus and forms to send requests to the system

***Developing database and file specification*:** The onlineDP will support multiple data and file format, it will store it in the application's storage directory with the file pointers stored in the database. The database developed using the Laravel artisan commands and manipulated through model classes–each model maps to a database table.

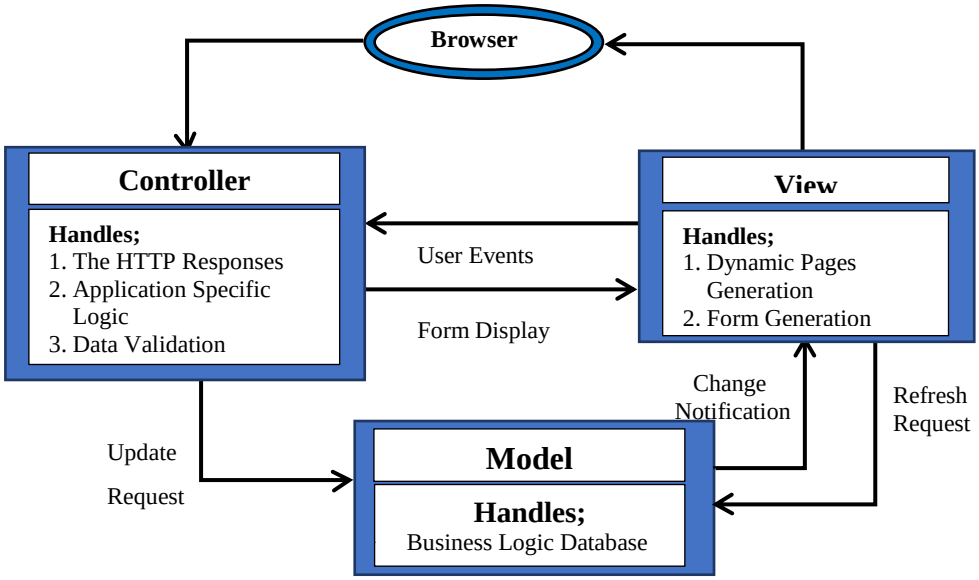


Figure 13: MVC web application controller (Sommerville, 2011, p. 156)

(iii) System Implementation

This is the final stage of the SDLC under involving the actual building of the system. It is the part that gets most of the attention needed for the software development project since it is the longest and the longer part; than any part of the software development process. It involves three stages: construction, installation and support plan (Satzinger, Jackson & Burd, 2012). However, this study did only with the first stage–building and testing of the system.

***System building*:** This study used the Laravel PHP framework to build the onlineDP, the responsive web-based group discussion application. This was due to number of reasons (John & Sam, 2018): Laravel supports MySQL which is the robust and most applied database server system and the MVC nature of Laravel which improves code maintenance, increases its reusability, scalability as well as security.

Building the backend: The backend of the onlineDP system was created using the Laravel's schema builder which eases the task of building the system's database schema. The Laravel schema facade endows a database with skeptical support for creating as well as manipulating tables in those database systems supported by Laravel, like MySQL. The Laravel's migrations controlled the versions of the database created using the migration artisan command. Artisan is the command-line that ships with Laravel which of several vital commands which can assist the developers when building an application.

Running the command creates a new migration class contains two methods up and down for adding new tables, or attributes and reversing the action respectively (Appendix 8). These methods can be overridden to manipulate the table fields including filling it with some initial data if needed. Executing the artisan migrate command writes the table to the database which was configured in the Laravel .env file.

Executing migrate artisan command hosts the database on the configured database system and writes the database tables based on the database schema. Finally, as per MVC nature, users can query database table(s) using its Model class, thus each migration has a corresponding Model class to manipulate it. The models created using the model artisan commands and took the capitalized names of the matching migrations.

***Building the frontend*:** To build the frontend of the onlineDP application, the interfaces built using blade. Blade is a powerful templating engine in Laravel which can easily be integrated with the bootstrap template for generating nice responsive layouts. The icons from the Font Awesome were used to cement out the beauty of the onlineDP interfaces.

Linkage between Model and View: The controllers used to pass the user request to the application's database the controllers. Each controller eloquently connected to the Model class and in the web.php file each controller mapped to the views that required it to communicate with the database. The visual studio code, integrated development environment was used as the editor during developing this application.

***Software validation*:** It intends to check and balance the system specifications and client expectations. It is pioneered by the program testing using simulated test; this legitimates it to be the most important validation part. In many cases it makes a greater share of validation cost to be spent during and after implementation of the system (Sommerville, 2011). Therefore, the application developed was tested up to the system integration using the test data and later the test from a user perspective was done.

Testing of the program as the primary validation technique is usually done to establish the quality assurance of the system under development, the quality of the product or service. It involves various stages such as the unit testing, integration testing, acceptance testing where customers conduct a test to find the quality of the system and many more (Ghuman, 2014; Sandin, Yassin & Mohamad, 2016).

Testing of the software is a very laborious and time-consuming, but very important activity of any software development (Ghuman, 2014), however, there is no shortcut route rather than to perform tests in all aspects of the software (Ammann & Offutt, 2008). Any testing conditions especially in OOP where codes split into classes and methods so that they get tested in isolation, here testing is regarded as the positive effect of testing. This can best be done using the unit test (Bean, 2015). Unit testing is a basic unit of any software testing that deals with the assessment of the software for the implementation and verifies the functionality of a particular code section (Ammann & Offutt, 2008; Ghuman, 2014).

The building of the software in this study mainly used the Laravel PHP framework. It allows pure OOP practices using the controller which transports the application logic to the presentation layer (Sinha, 2017). The application codes split into classes, based on tasks dedicated to a class. Moreover, the development followed the scrum approach which allows to sprinting over and over.

3.3.2 Adaptive SDLC Approach

Under this approach to SDLC, the changed circumstances of the core software development activities of planning and modeling the software development process are instantaneously accommodated; when the process is underway.

It is iteration oriented wherein each iterative stage involves the creation of small-sized activities depicting the small parts of the application. These get analyzed and designed, developed and tested (Satzinger, Jackson & Burd, 2012); this entails that when the requirements are not known in advance this approach chips in.

In fact, under this study, the requirements were not known before; expected to vary. This now marks the reason to why this study adopted the adaptive approach. In the same regard, it adopted an agile methodology and the Scrum method.

It is a philosophy and set of guidelines applied to develop an information system in unknown and rapidly changing circumstances. Usually, it complements adaptive approaches to the SDLC (Satzinger, Jackson & Burd, 2012).

3.3.3 The Object-Oriented Approach

This approach views information system as the collection of self-contained objects having both the data and processes, working together to achieve a desired task, an object is referred

to as anything in computer system that has a capability of responding to messages (Alan, Wixom & Tegarden, 2015; Satzinger, Jackson & Burd, 2012).

The onlineDP is the web application that offers interaction between students, course instructors, moderators and administrators. It uses an API to interact with the UMBC semantic comparisons service (Han, Kashyap, Finin, Mayfield & Weese, 2013), thus modeling it using the object-oriented approach serves as the best approach. This will provide a clear picture of how these objects interact and exchange messages (contents).

Kendall and Kendall (2011), argue that in an object-oriented approach, the methodology works to discover classes and its attributes, methods, as well as the relationships that exist between the classes. Therefore, since programming occurs at class levels, it is significant to define classes during object-oriented analysis. In this study, main classes were classified and modeled using the class diagram.

3.3.4 Scrum

This is the general agile method that focuses mainly on handling iteration rather than casting a look at the specific technical agile software engineering. It is the combination of rugby and agile manifesto; therefore it quick, agile as well as an intense software development methodology. It has outline planning phase, sprint cycles phase and project closure phase. Moreover, Scrum fits into dominant adaptive software development methodology (Satzinger, Jackson & Burd, 2012; Sommerville, 2011). Scrum tallies the adopted adaptive SDLC approach.

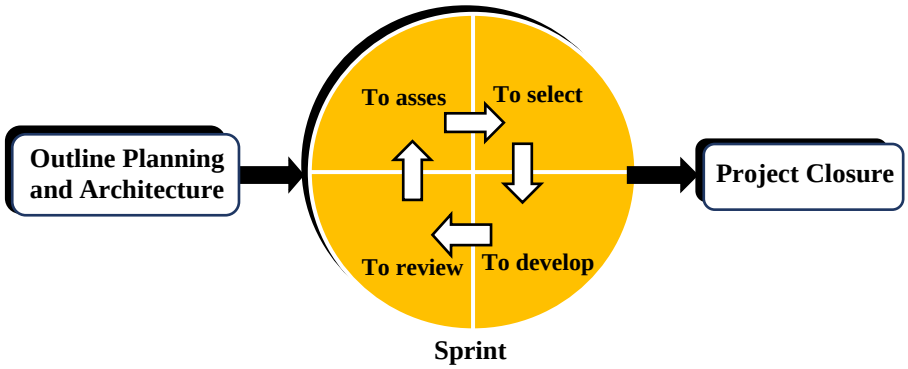


Figure 14: The scrum phases and process

(i) Outline planning phase

This phase deals with the establishment of the objectives and software architecture design. The objective was to develop the responsive online discussion platform which in turn will ensure the collaborative learning environment in HLIs. Since an MVC framework was used to develop the web application, hence it necessitated the adoption of web application architecture using the MVC pattern (Sommerville, 2011).

(ii) Sprint cycles

This is the innovative phase where the project plans and asses the work and then features are chosen for development and then implemented. Finally, when sprint ends, the finished functionality is delivered. This means that every complete cycle is equivalent to one system increment.

(iii) Project closure

This is the last step; it is the closure point of the project which is used for assessment of the learned lesson. Nonetheless, it produces essential documentation such as help frames. This stage involved the preparation of a readme files (Appendix 9), showing how to install and use the system.

3.3.5 Tools and Materials

The tools and techniques in Table 5 were used to make sure that the onlineDP becomes certain out of the adapted SDLC. They include programming languages and techniques, APIs, frameworks and development integrated development environments (IDEs) such as Visual Studio Code.

3.4 Ethical Consideration

Before commencing this study, the researcher sought permission from NM-AIST. The Dean's office issued an introductory letter to introduce a researcher which requested profound permission to carry out a study in a particular institution (Appendices 1 and 2) Are the introductory letter with the cover letter written to seek permission to collect data from UoA. Following the permission grant, the process of data collection began without ambiguities and fear, meanwhile abiding by ethical principles such as respect, integrity and privacy considerations. During the system implementation, building the system, a researcher

used the Swoogle API from the UMBC semantic similarity service where the permission was successfully granted; (Appendix 3).

Table 5: Tools and techniques used

Name	Description	Uses
MySQL	Database server	Served after Laravel-model migration command and other transactions.
Laravel	PHP-MVC Framework	For development and test of both frontend and backend of the application.
Swoogle API	UMBC semantic comparison /similarity service API	For a semantic comparison of different phrases and words.
Visual Studio Code (VSC)	An integrated Development Environment (IDE)	The IDE used for development of the application.
Font awesome	The iconic websites	For different icons used in the application.
AdminLTE	A bootstrap based web Control Panel Template.	Integrating with Blade Laravel templating engine for responsive user interfaces.
Browser	Any of the current browsers e.g. Google chrome V.70+	For web view of the system's front and back ends.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

The previous chapter discussed the rational selection and organization of different materials, methods and techniques to seek answers to the research questions. It helped to attain answers this research presents in this chapter in the form of research results. The logical organization became of assistance in carrying out this research study from data collection, analysis and elicitation of system requirements to the system development and testing. Therefore, this chapter presents the results obtained after the analysis of the data collected, requirements formulation and system development. Finally, it gives an in-depth results discussion that shows that this research achieved its specific objectives.

For this research study to have substantive information to respond to the research questions; it involved five HLIs from Arusha region and 96 respondents from the selected HLIs.

4.2 Findings from the Respondents

4.2.1 Demographic Characteristics of Respondents

The demographic information of the respondents included gender, age, HLI and the residence of a respondent when on studies. Most of these characteristics held a pivotal role during analysis and discussion over the respondents' states towards the recommendation of the online discussion platform as an effective means that can enhance the effectiveness in collaborative learning in HLIs in Tanzania.

Table 6 summarizes demographic information for respondents. Out of 96 respondents, 63.5% were males, 35.4% females; and 1.1% did not specify their gender. The majority (84.4%) had their ages falling in the age group of 21-30 years; only 15.6% had the age falling between 31 and 40 years.

Furthermore, about the surveyed HLIs, ATC had the largest share of 57.3% of the total number of respondents. Then IAA followed with 21.9% of the respondents. The number of respondents from NM-AIST coincided that of UoA, each had 7.3% of the total respondents; the TUMA had the entirety least number, 4.2% of respondents and 2% of all respondents did not indicate their HILs.

Finally, about 60.4% of the participants lived off-campus, while only 39.6% lived on campus.

Table 6: Demographic information of respondents

Demographic Characteristic		Respondents	Percentages(%)
Gender	Female	34	35.4
	Male	61	63.5
Age	21-30	81	84.4
	31-40	15	15.6
HLI	ATC	55	57.3
	IAA	21	21.9
	NM-AIST	7	7.3
	TUMA	4	4.2
	UoA	7	7.3
Residence	On-Campus	38	39.6
	Off-Campus	58	60.4

4.2.2 Computing Devices Ownership

Figure 15 is the pie chart that presents how the ownership of computing devices among respondents was. It shows that there was no difference between the numbers of respondents owned mobile phones and those owned computers, each owned by 47.2%. The tablet was the least owned computing device possessed by only 5.6% of the respondents.

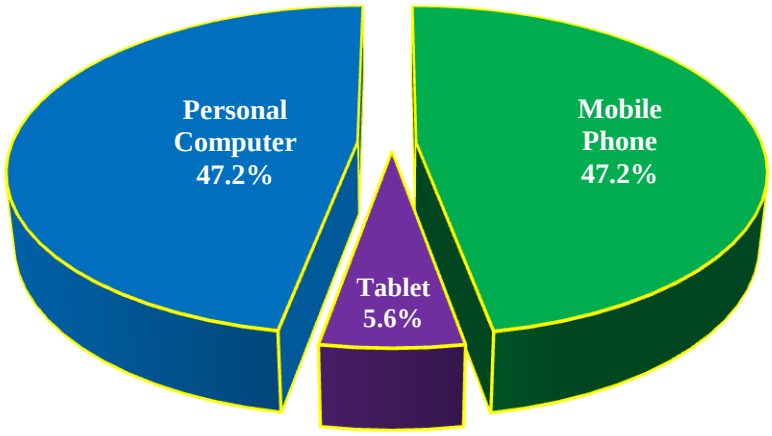


Figure 15: Computing devices ownership

Nonetheless, one among the respondents listed a scientific calculator as a computing device. However, the analysis did not include it since the interest was solely for those devices which may allow connecting to the Internet.

4.2.3 Computing Devices Used Versus Used Internet Connection Technology

Table 7 shows how respondents used mobile phones, tablets and personal computers to access Internet. Additionally, it presents how they used mobile or modem technology to connect their devices to the Internet. Furthermore, it indicates that some respondents used none of these technologies when connecting their devices to the Internet.

Among all connection, 53.3% of them were from respondents who used mobile phones to access Internet, 42.4% were from those who accessed Internet via personal computers and 4.2% were from those who access Internet using their tablets.

Overall, 75.8% of the total connections were from respondents who used mobile connection technology. Among these, 56.8 % were from respondents who used mobile phones, 39.2% from those who used personal computers and 4% from those used tablets to access Internet. Therefore, the majority of respondents who used mobile phones used mobile connection technology to connect their devices to the Internet.

Table 7: Cross tabulation showing connection devices against connection technologies

Connection Technology	**Percentage (%)**	**Device used to access Internet**			**Total**
		Mobile Phone	Tablet	Personal Computer	
Modem	within	42.1	5.3	52.6	
	of Total	9.7	1.2	12.1	23.0
Mobile	Within	56.8	4.0	39.2	
	of Total	43.0	3.0	29.7	75.8
None	within	50.0	0.0	50.0	
	of Total	0.6	0.0	0.6	1.2
Total	of Total	53.3	4.2	42.4	100.0

Percentages and totals are based on responses.

On the other side, 23% of all respondents used modem connection technology wherein 52.6% of the respondents used personal computers, 42.1% were those used mobile phones, 5.3% were those respondents who used the tablets for accessing the Internet and 1.2% used neither of the technologies. Furthermore, the majority of those used personal computers to access the Internet used modem technology to connect their devices to the Internet.

4.2.4 Frequency of Using Internet for Studying Residence Wise

Figure 16 presents a multiple line graph that shows the comparison of Internet usage frequency among the respondents, residences wise. It indicates that the majority of on-

campus respondents used the Internet from two to three days per week. But, only a few of them frequently used the Internet from four days and above.

On the other hand, the majority of the off-campus respondents used the Internet frequently; more than half of them used it for at least two days. The percentage of off-campus respondents who used the Internet was more or less proportional to the increase in frequencies. Nonetheless, some respondents seldom used the Internet.

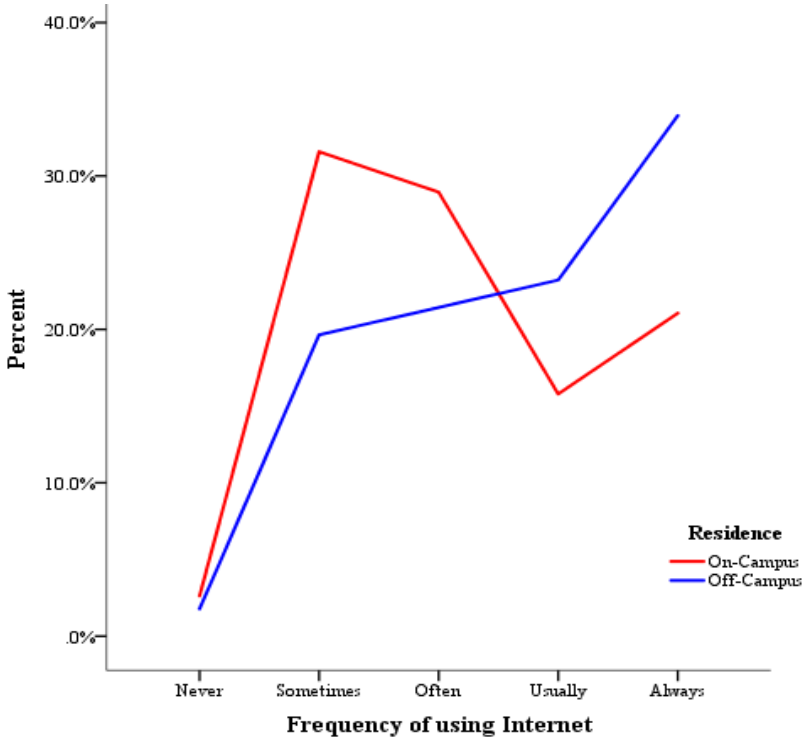


Figure 16: Multiple line graph by internet usage frequency and residence

4.2.5 Internet Usage among HLIs

Table 8 indicates how the respondents from surveyed HLIs used the Internet for various academic activities. They used it for downloading materials, reading notes, attending conferences, or for accessing videos and articles/ tutorials.

About 58.4% of all respondents from ATC used the Internet for various activities, the majority (32%) spent on downloading activities and 19.2% of the overall respondents from IAA used the Internet for different activities where many of them, 38.3% used it for downloading as well. The NM-AIST had the third large share (13.5%) of Internet usages. Contrary to other HLIs whose majority of their respondents used the Internet for downloading activity, the majority, 21.2% of respondents from NM-AIST used the Internet for accessing video/ tutorials.

Eventually, the respondents from TUMA and UoA respectively contributed only 4.1% and 4.9% of the total Internet usages.

Downloading was the most activity that most of the respondents spent on when using the Internet. More than 32% of the total Internet usage was from it; reading followed with 20% of the total Internet usage. The third activity was accessing video/tutorials with about 19% of total Internet usage.

Furthermore, sharing or uploading was the fourth activity, contributed 13.2% of the total Internet usages. The activity that had the least Internet usage was attending the conferences which had only 0.8% of the total Internet usage–this was solely contributed from the NM-AIST respondents.

Table 8: Crosstabulation showing Internet usage among surveyed HLIs

HLI	**Percentage (%)**	**Uses of Internet**					**Total**
		Downloading	Sharing or Uploading	Reading	Video/ Tutorials	Attending Conferences	
ATC	within	32.2	14.0	18.9	21.7	0.0	
	of Total	18.8	8.2	11.0	12.7	0.0	58.4
IAA	within	38.3	12.8	19.1	14.9	0.0	
	of Total	7.3	2.4	3.7	2.9	0.0	19.2
NM-AIST	within	18.2	15.2	18.2	21.2	6.1	
	of Total	2.4	2.0	2.4	2.9	0.8	13.5
TUMA	within	40.0	10.0	30.0	10.0	0.0	
	of Total	1.6	0.4	1.2	0.4	0.0	4.1
UoA	within	50.0	8.3	33.3	8.3	0.0	
	of Total	2.4	0.4	1.6	0.4	0.0	4.9
Total	of Total	32.7	13.5	20.0	19.2	0.8	100.0

Percentages and totals are based on responses.

4.2.6 Internet Usage Based on Residences

Table 9 shows that there is a distinction between Internet usages among the respondents, residence wise. The off-campus respondents overall underscore higher Internet usage than their counterparts, those residing on campus. Off-campus, respondents counted 53% of the total Internet usage, while only 47% were from those living on campus.

Furthermore, downloading activity was the most activity that the majority of respondents mostly spent on when using the Internet, 32.4% of them used the Internet for downloading. Additionally, it was the leading activity within residences; 28.6% and 35.8% of respondents from on-campus and off-campus used the Internet for downloading, respectively.

Finally, the reading activity followed in which within on-campus respondents 19.3% of them used the Internet for reading and 20.1% of respondents from off-campus accessed the same activity.

Table 9: Cross tabulation indicating Internet usages residences wise

Residence	**Percentage (%)**	**Uses of Internet**					**Total**
		Downloading	Reading	Accessing Articles	Accessing Video/ Tutorials	Attending Conferences	
On-Campus	Within	28.6	19.3	17.6	18.5	1.7	
	of Total	13.4	9.1	8.3	8.7	0.8	47.0
Off-Campus	Within	35.8	20.1	11.2	20.1	0.0	
	of Total	19.0	10.7	5.9	10.7	0.0	53.0
Total	of Total	32.4	19.8	14.2	19.4	0.8	100.0

Percentages and totals are based on responses.

4.2.7 Social Media uses for Various Activities

Table 10 shows how respondents used social media for chatting, academic issues, getting news, posting and sharing; additionally, it shows that 0.1% of the respondents did not indicate the social media they use albeit having chatted on social media.

Many respondents, 25.9% used WhatsApp in doing the activities; about 23.9% of the respondents who used WhatsApp used it for chatting and getting the news. Only 20.5% of them used it for academic issues. Moreover, 18.9% and 12.9% of respondents who used WhatsApp used it for sharing and posting respectively.

About 21% of the respondents used YouTube for the activities. Among them, 25.7% of them used it for getting news; only 21.5% of them used it for academic issues. Furthermore, the rest used it for chatting (22.4%), academic issues (21.5%), sharing (18.2%) and posting (12.1%).

Table 10: Cross tabulation indicating how students use social media for various activities

Social Media	Percentage (%)	Uses of Social Media					Total
		Chatting	Academic Issues	Getting News	Posting	Sharing	
Facebook	Within	23.5	19.2	23.9	13.1	20.2	
	of Total	4.9	4.0	5.0	2.7	4.2	20.9
YouTube	Within	22.4	21.5	25.7	12.1	18.2	
	of Total	4.7	4.5	5.4	2.5	3.8	21.0
Instagram	within	24.5	20.8	25.5	11.5	17.7	
	of Total	4.6	3.9	4.8	2.2	3.3	18.8
WhatsApp	Within	23.9	20.5	23.9	12.9	18.9	
	of Total	6.2	5.3	6.2	3.3	4.9	25.9
Twitter	within	22.6	19.0	25.0	16.7	16.7	
	of Total	1.9	1.6	2.1	1.4	1.4	8.2
Telegram	within	25.0	16.7	25.0	11.1	22.2	
	of Total	0.9	0.6	0.9	0.4	0.8	3.5
LinkedIn	within	21.4	21.4	28.6	14.3	14.3	
	of Total	0.3	0.3	0.4	0.2	0.2	1.4
Viber	within	50.0	0.0	50.0	0.0	0.0	
	of Total	0.1	0.0	0.1	0.0	0.0	0.2
Never Used	within	100.0	0.0	0.0	0.0	0.0	
Any	of Total	0.1	0.0	0.0	0.0	0.0	0.1
Total	of Total	23.6	20.2	24.8	12.7	18.6	100.0

Percentages and totals are based on responses.

About 20.9% of the respondents used Facebook for similar activities wherein 23.9% and 23.5% of them used it for getting news and chatting respectively. Only 19.2% of them used Facebook for academic issues, while 20.2% and 13.1% of Facebook users used it for sharing and posting activities, respectively.

Moreover, the priority for respondents was to get news on social media than doing any other activity. Thus, the majority (24.8%) of them overall used these social platforms for accessing news, seconded chatting wherein about 23.6% of them used social media for chatting. They further placed the academic issues at the third place, where 20.2% of respondents spent part of their time on social media for the activity. Eventually, 12.7% and 18.6% used social media for sharing and posting different issues on social media.

Generally, respondents used social media for academic activities; all listed social media, except Viber, had respondents who used them for academic activities. However, using social media for academic issues was not their priority. Finally, they preferred sharing than posting new things on social media.

4.2.8 Challenges of Using Social Media as a Learning Tool

Figure 17 indicates the challenges faced by the respondents who used social media for academic purposes. More than 51% reported facing Internet and connection challenges, over 26% of them pointed out the challenge from uncertainties nature of learning materials found on social media. About 22% of the respondents reported a lack of moderation and control over the discussions on social media.

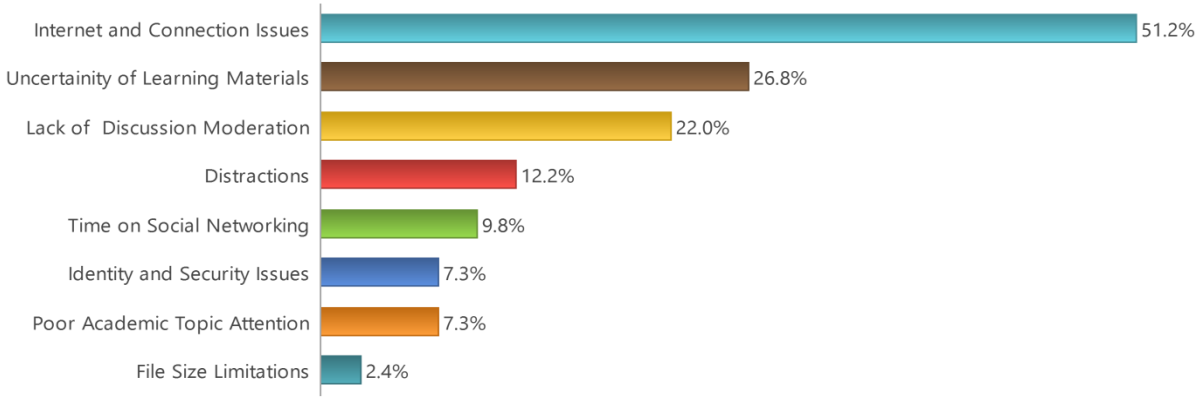


Figure 17: Challenges when using social media for academic issues

Furthermore, 12.2% reported that there are ads distractions from social media, 9.8% reported to spend much time on social networking than the time they spend on academic activities. Moreover, 7.3% reported that there is poor attention paid towards academic topics and that there are problems concerning identity and security. Lastly, 2.4% of the respondents complained of the limitation of the file size to upload on social networking sites.

4.2.9 Knowledge and Usage of LMS in the Surveyed HLIs

Table 11 indicates the knowledge respondents had over learning management systems (LMSs) and the trend of using them for various learning activities.

It shows that the majority of respondents (59.4%) had used LMS for various learning activities and only 40.6% of them had never used LMS.

While 53% and 36.5% of these respondents respectively cognized and used the Moodle system, 21.9% of the respondents cognized and used the Blackboard system and the Sakai

system was the least known and used LMS, only 4.2% and 2.1% of the respondents cognized and used it respectively.

Eventually, more than 15% of the respondents were incognizant of LMS. However, this amount might not be true since1% of those who reported being incognizant had used LMS; this might be due to the confusion they had from the word Blackboard in the Blackboard system, it was indeed confused with chalkboard**.** For instance, two respondents mention challenges they faced when using LMS one said "*For blackboard sometimes we must be face to face and it is difficult*" and another responded dust*;* these may not be the challenges one can anticipate from an LMS.

Table 11: Cross tabulation on LMS knowing and usages

Used LMS	**Percentage (%)**	**Known Learning Management Systems**					**Total**
		Moodle	BlackBoard	Sakai	WebCT	None	
Yes	of Total	36.5	15.6	2.1	4.2	1.0	59.4
No	of Total	16.7	6.3	2.1	1.0	14.6	40.6
Total		53.1	21.9	4.2	5.2	15.6	100.0

Percentages and totals are based on responses.

4.2.10 Challenges Faced by Respondents Used LMS

Figure 18 presents what challenges respondent perceived to be faced by the respondents who used LMS. 60.5% of them reported Internet connection problems; meanwhile, 41.9% and 11.6% respectively reported that the challenges from LMS system quality and volatile nature of LMS from its configurations. The knowledge on the use of LMS was the other challenge reported by 9.3% of them. Moreover, 7% reported a lack of materials and computing devices to use to access LMS. Finally, 4.7% reported the ambiguities, especially from the vocabularies, use in LMS and only a few (2.3%) reported power issues as the challenge when using LMS.

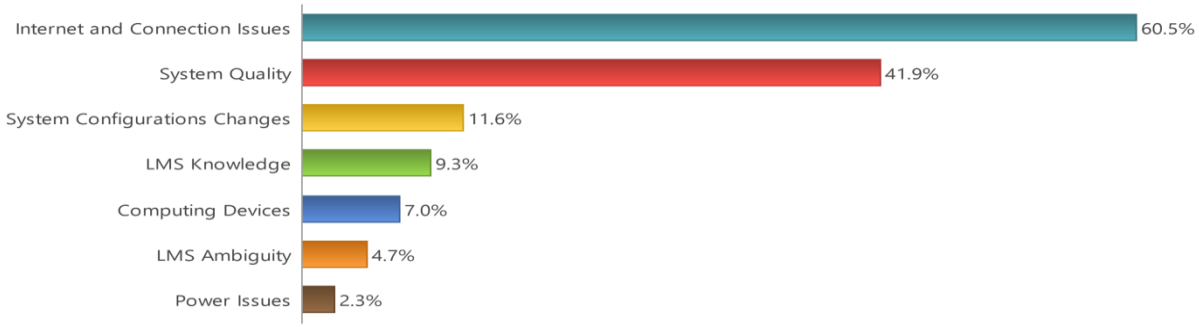


Figure 18: Challenges faced during using the LMS

4.2.11 Online Discussion Platform Usages for Academic Discussion

Figure 19 illustrates that only 28% of the respondents had never used an online discussion platform in their academic discussion. The rest had done so using various discussion forums found in different systems.

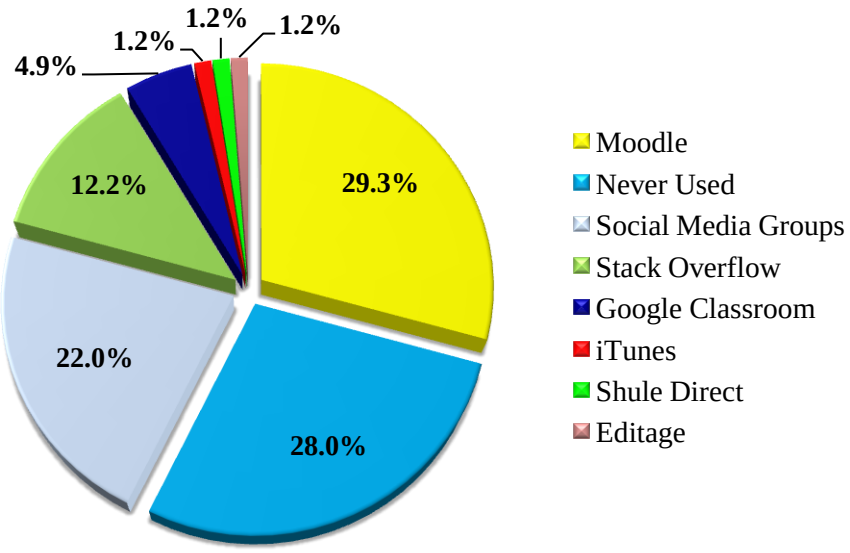


Figure 19: The online discussion platforms used for academic purposes

The Moodle system discussion forum concealed the rest by having been used by 29.3% of the respondents. It was followed by social media groups that had been used by about 22% of the respondents; then stack overflow website goes behind by having been used by 12.2% of the respondents. Moreover, 4.9% of the respondents had used the Google classroom system to conduct their academic discussions online. Finally, iTunes, ShuleDirect and Editage were each used by 1.2% of the respondents.

4.2.12 Challenges Faced when Using Online Discussion platform for Academic

There are numerous challenges associated with using online discussion platforms for academic issues; Fig. 20 illustrates the challenges pointed by the respondents. The majority (67.9%) reported matters concerned with the Internet and network connection in general, issues related to limited Internet bundles and low speed of internet.

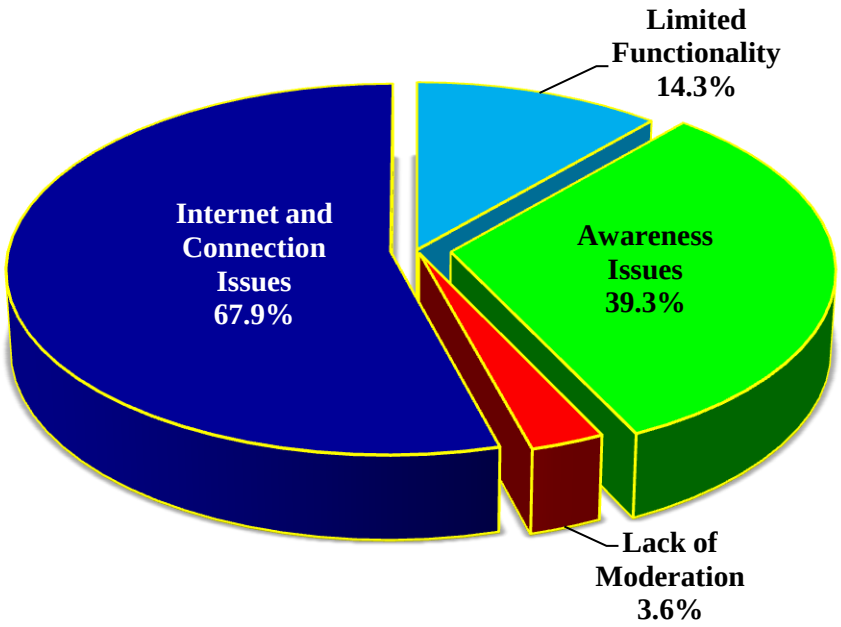


Figure 20: Challenges faced when using online discussion platform

For instance, one respondent said, "*Meet others have no data it becomes very difficult to conduct a discussion,*" and another said it is "*slow in uploading and downloading materials.*" About 39.3% reported having lacked general awareness and knowledge about online discussion platforms. About 14.3% reported that they faced limited functionality problems from the online discussion platform they used and 3.6% felt a lack of moderation of the discussions and topics in general. For instance, one respondent said "*it is very common to meet participants posting different materials from the academic one*".

4.2.13 Meeting Situation versus Online Discussion Platform Recommendations

This study needed to investigate the relationship existing between the situations faced by respondents when meeting for academic discussion and their online discussion platform recommendations. To achieve this, the study employed the Pearson linear correlation.

The findings in Table 12 show that the situation respondents faced when meeting for discussion and their recommendations on the online discussion platform had a statistically significant positive linear relationship ($r = 0.377, p < 0.01$).

Table 12: Correlations between meeting situation for discussion and online discussion platform recommendations

		The situation during meeting for group discussion	Online Discussion Platform Recommendation
The situation during meeting for group discussion	Pearson Correlation	1	0.377**
	Sig. (2-tailed)		0.001
	N	93	81
Online Discussion Platform Recommendation	Pearson Correlation	0.377**	1
	Sig. (2-tailed)	0.001	
	N	81	83

***. Correlation is significant at the 0.01 level (2-tailed).*

4.2.14 How Residences and Online Discussion Platform Recommendation Related

From the Table 13, the p-value is 0.938 which is greater than the chosen significant level $\alpha = 0.05$. This signifies that there was no significant association between the recommendation of an online discussion platform and the individuals' residences. Figure 21 also, indicates the trend for online discussion platform recommendations within the on-campus and off-campus respondents; it was low for those who fairly recommended and increased towards those who strongly recommended the online discussion platform. Therefore, the online discussion platform found to be a need for all individuals in HLIs regardless of their residences.

Table 13: Residence against online discussion platform recommendation Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	.128[a]	2	.938
Likelihood Ratio	.129	2	.937
Linear-by-Linear Association	.039	1	.842
N of Valid Cases	83		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.57.

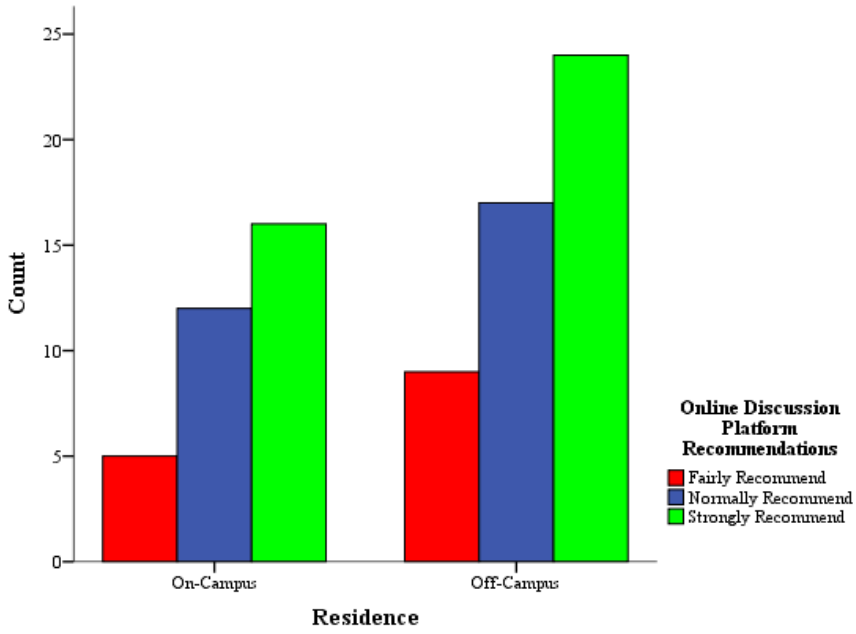


Figure 21: How students recommend online discussion platform

4.3 Requirement Definition

4.3.1 Services Respondents Would Like to Receive Online Discussion Platform

Figure 22 illustrates various services that respondents aspired to get from the online discussion platform. About 40.9% and 6.8% of the respondents would like to be able to carry out normal and live discussions, respectively. Additionally, 38.6% would like to use the platform to access various learning materials. Moreover, 20.5% required the service to post and share materials and information and 15.9% required the content and discussion moderation. Eventually, 11% of the respondents needed chatting functionality.

Furthermore, 9.1% of the respondents correspondingly required the platform to be user-friendly, to be available, allow them to comment and to be able to collaborate beyond institutions, for example, a respondent requested “Sharing materials between different institutes”. Moreover, 6.8% of respondents respectively required from the platform to be very secure and allowing them to upload and download materials. Additionally, 4.5% of the respondents respectively required the system to provide interactivity, inviting an expert to resolve disagreements and the system should be able to recommend learning materials. Ultimately, 2.5% would like the platform to respectively require the system to limit the number of group members, enable them to submit assignments and offer them with multimedia.

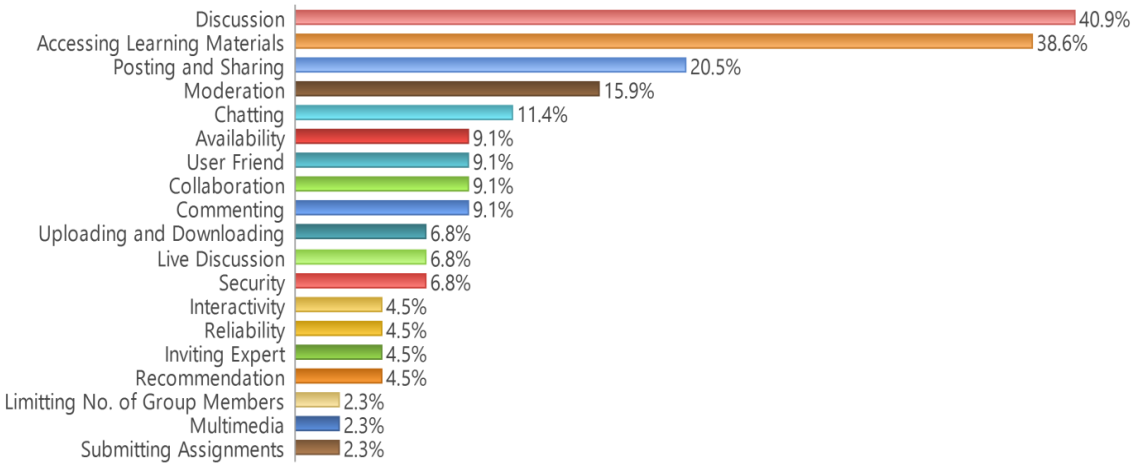


Figure 22: Online discussion platform requirements.

4.3.2 Functional and Non-Functional Requirements

Principally, functional and non-functional requirements lay down a guideline for implementing an information system. Therefore, in this study, the collected system requirements (mainly from Fig. 22) were categorized into two groups of requirements: the function and non-functional requirements. They are presented in Tables 14 and 15, respectively.

Table 14: Functional requirements for online discussion platform (onlineDP)

Requirement	Description	Actor(s)
User's account managements	➢ All users shall be registered by administrators and each user should be able to create and manage a profile. ➢ Each user shall be allowed to change a password at any time.	System Administrators and Users
Virtual discussion environment	➢ The system shall allow users to initiate a discussion topic. ➢ The system shall allow users to participate group discussion.	Instructors and students
Content redundancy Control	➢ onlineDP shall semantically check for contents similarity before gets posted	UMBC Semantic similarity service
Content Moderation	➢ The system shall allow the moderators to moderate posted contents before is publicly available	Moderators and instructors

Table 15: Non-functional requirements for online discussion platform (onlineDP)

Requirement	Description
Security	➢ onlineDP system should ensure that all users passwords are strongly hashed with bcrypt helper (Bean, 2015) using the Laravel hash class, the bcrypt algorithm (John & Sam, 2018) so that the passwords may not be jeopardized. ➢ The System should authenticate all users before allowing them to interact with the system functionalities.
Maintainability	➢ The system should be easy maintained. ➢ It should be able to add new menus, functionalities and features without any major redesign.
Operating System	➢ It should be a cross-platform of all browsers on mobile devices and computers, desktops or laptops.
Robustness	➢ The system should continue function accurately even if something wrong happens or multiple queries are received at the same instant.
Scalability	➢ The system should be easy scalable, it should be able to expand depending on the demands.
Language	➢ The system should be implemented in English and checks the semantics of the queries based on English language.

4.4 System Modeling

4.4.1 Use Case Diagram

Table 14 shows the possible interactions between the system administrator and other users: moderators, instructors and students. This interaction is further analyzed using the use case diagram in Fig. 23. In the onlineDP application, the Person and its descendants: moderator, instructor and student are the primary actors. On the other side, the UMBC Semantic similarity service and administrator are the secondary actors of the system, which will support the system to make sure it delivers its services very well to the system's primary actors.

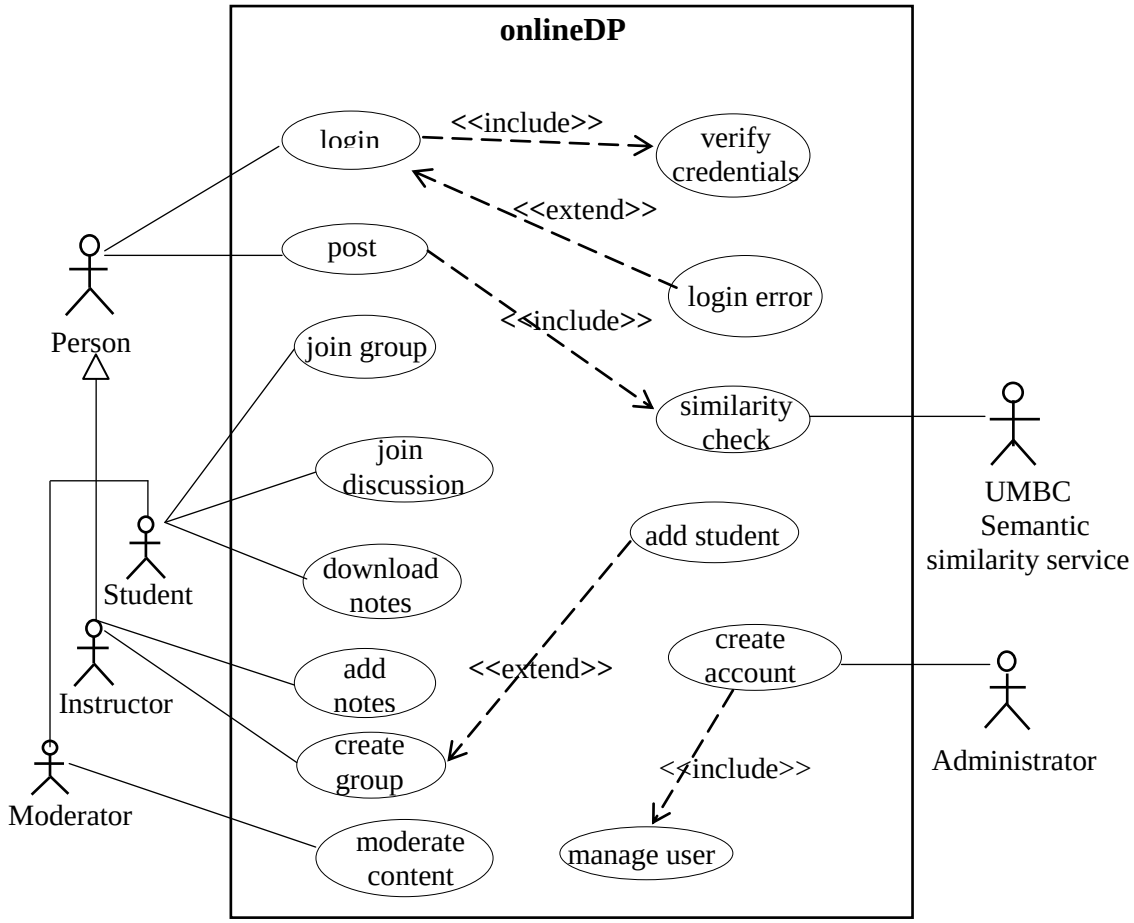


Figure 23: Use case diagram for onlineDP

4.4.2 Sequence Diagram

Figure 24 is a sequence diagram that shows how various onlineDP processes happen in order and time; it shows which messages flow in the system. Additionally the sequence diagram shows how the interaction between the objects happens.

Moreover, the sequence diagram shows that users have to pass all requests through a view, element boundary (user interface) to the controller, element control (user interface controller). The controllers then request data from other entities or database model(s); this point makes sure that the request is complete and interprets what responses required to fulfill the user's requests. Before a user performs anything to the system must get authenticated and then other processes continue. The operations are sent back and forth to the controller via the user interface.

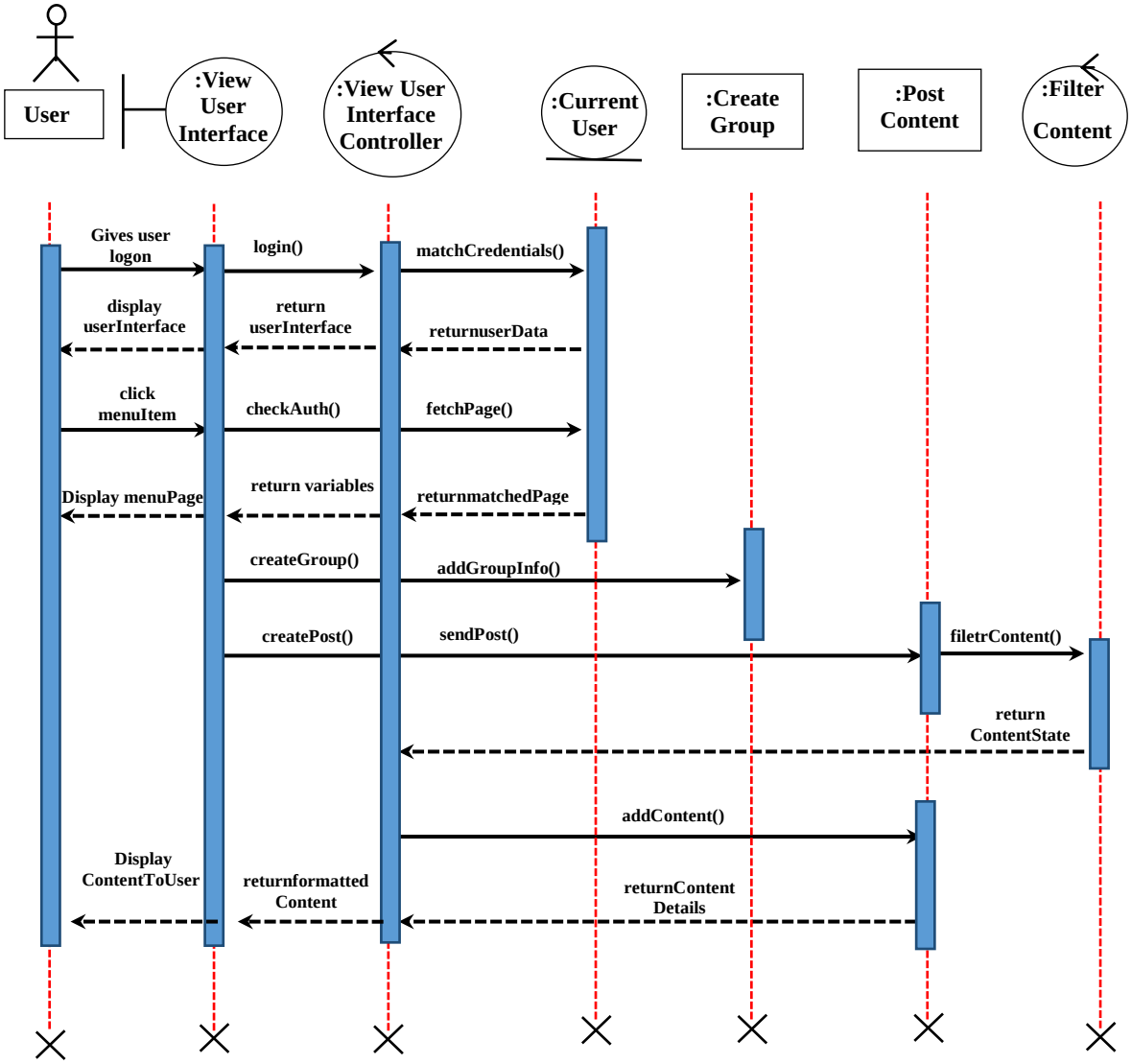


Figure 24: onlineDP sequence diagram

4.4.3 Class Diagram

Figure 25 is the class diagram depicting the structure of the onlineDP, class-wise; it shows the structure of the main processes of the application. For instance, the creation of the group may either be automatically or manually, where the creation of manual groups when may involve manual addition of students or students can join it later. However, currently, the application can allow the instructors to create groups for the students manually. Additionally, when the post is posted must be sent for similarity checking, this is an algorithm which uses the UMBC semantic similarity service API to calculate the match between any posted content against what is in the application.

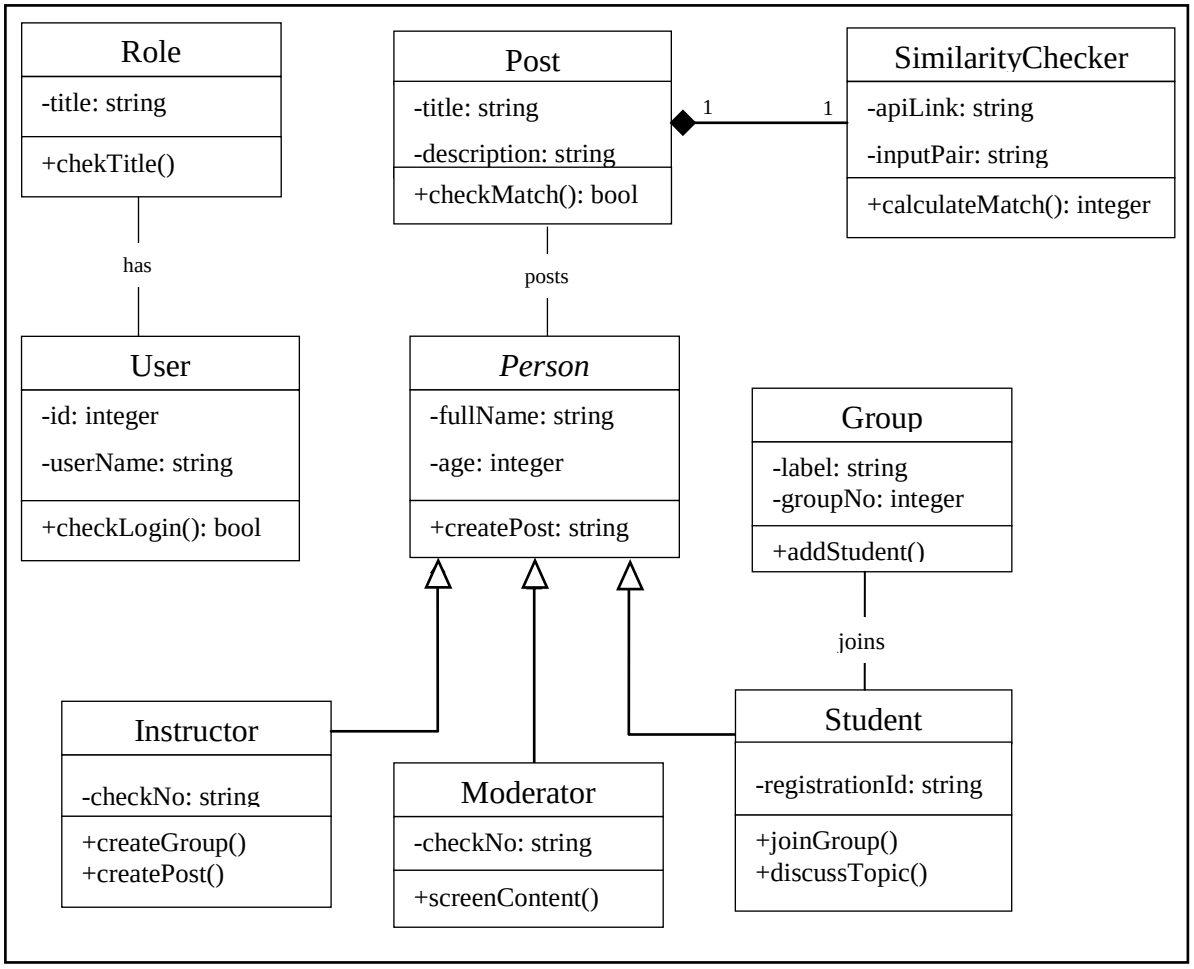


Figure 25: The onlineDP class diagram

4.5 System Design

4.5.1 Architectural Design

Figure 26 shows onlineDP architectural design that follows after requirement analysis and modeling, the conceptual framework and the MVC web-based application architecture. The architecture shows how various main operations and their sequences happen.

The onlineDP receives inputs from the users either as a file upload through (1a) or as a post/ question via (1b). It moderates the uploaded file(s) or content before it permanently stores it in the database. It checks post/ question for redundancy by comparing it against the database's contents (2a) and sends each pair to UMBC semantic similarity check service. It goes through (3) for percentage matches calculation and then filtered via (4), if the percentage match is greater than 50% then goes through (5a) else goes through (5b) for moderation and for being stored into the database. A stored content goes through (6) for the general uses.

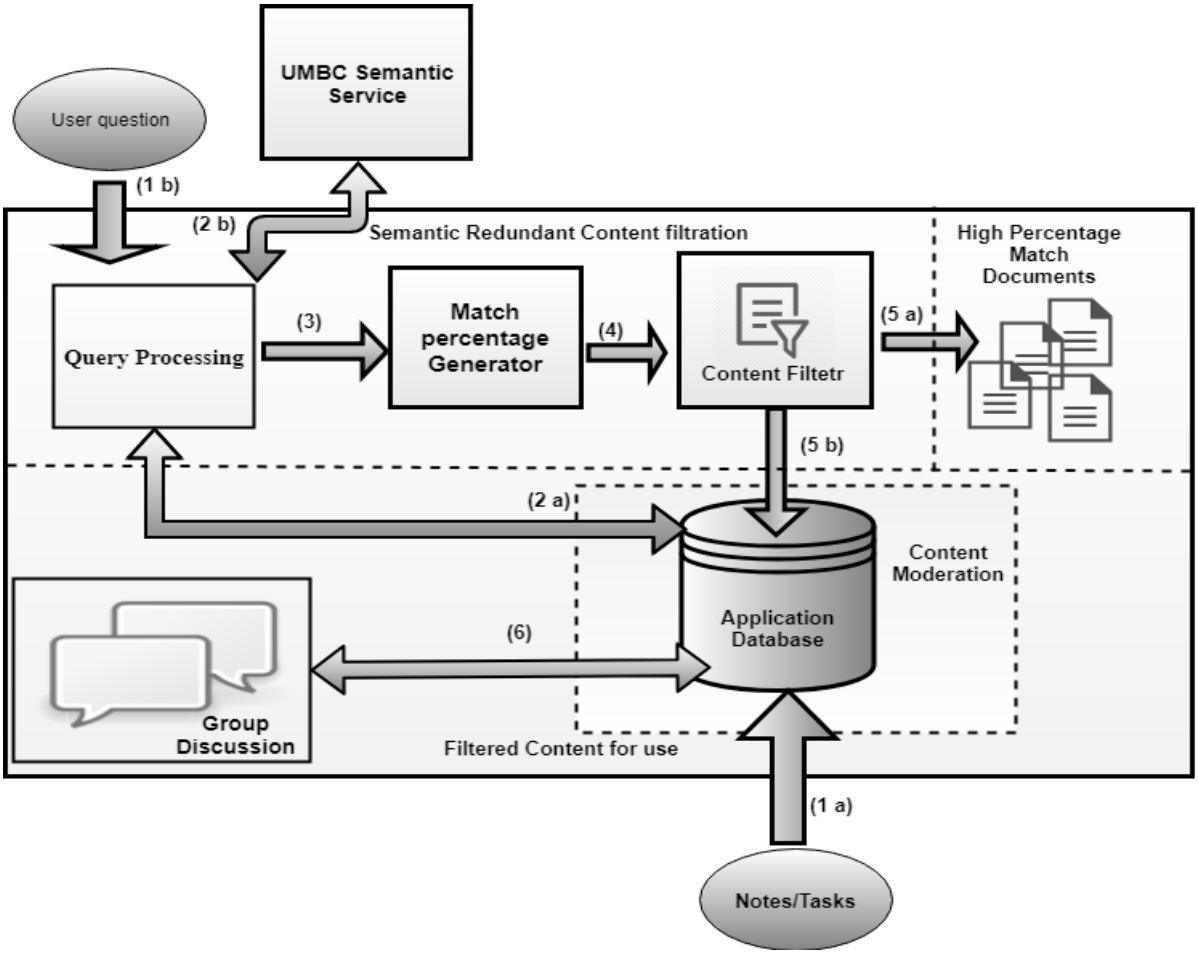


Figure 26: The architectural model for the onlineDP

4.5.2 Database Design

The database is primarily supported by the MySQL database server. It uses the model classes to map the application operations. The onlineDP has 30 database tables, which are the result of main entities and others were from the relationships holding between the entities as they reflect from the requirement analysis. Nonetheless, the other tables may not be directly reflecting entities indicated in the class diagram because the entities presented in the requirement modeling are only the main ones. Figure 27 shows the snapshot of some of the database tables' schema.

4.6 System Implementation

4.6.1 Database Implementation

The database was implemented using the Laravel's schema facades; was hosted on the MySQL database server. By using Laravel's schema builder, it becomes easier to manipulate the database structure and the relationships between the tables on the database systems that

are supported by it. After configuration of the database server (MySQL), configuring database name in Laravel and the execution of the migrate command. The migrations were written off in the MySQL server. The relational schema in Fig. 27 showing the entity relations was exported.

To perform record manipulation in the database a user must use the interfaces provided. The interfaces send user requests to the controllers which eloquently communicate with the models mapped to database tables.

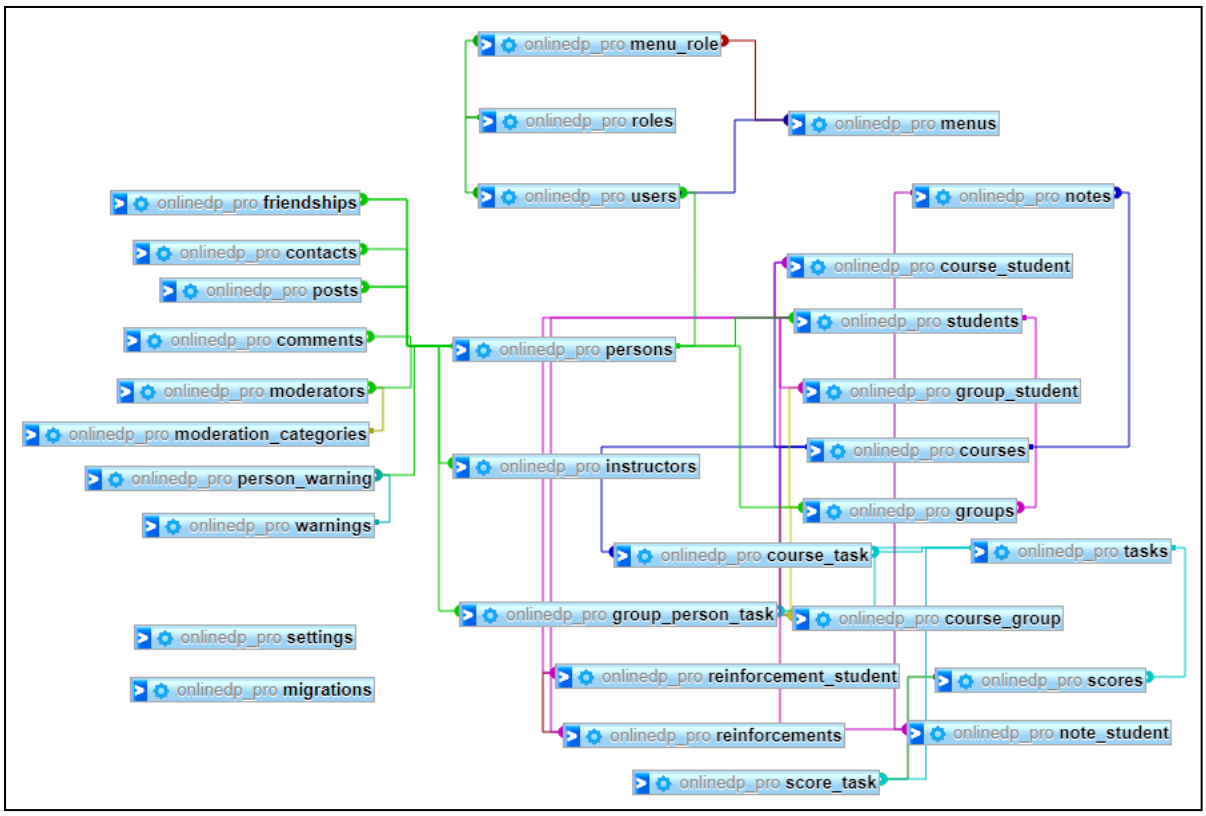


Figure 27: The onlineDP entity relational schema

4.6.2 The onlineDP Application Implementation

The onlineDP is an MVC responsive web-based application that is cross-platform for browsers. It was mainly built using the Laravel PHP Framework. Its frontend consists of bootstrap interfaces from the adminLTE and icons from the Font Awesome. The frontend is linked to the backend through the controllers which are translators and manipulators between the user and data or information stored in the application's database. All codes were edited using Visual studio code version 1.37.1.

All users must be registered into the system to have a privilege to log into the system using the username and password. Figure 28 and 29 are the registration and login pages, respectively.

(i) Registration Page

The registration page adds extra fields depending on the selected user role, for student role the admitted date field comes and for moderator role the moderation category field comes. When successfully registered as a user the administrator gets the popup notifications indicating the name a user registered with and the role registered to.

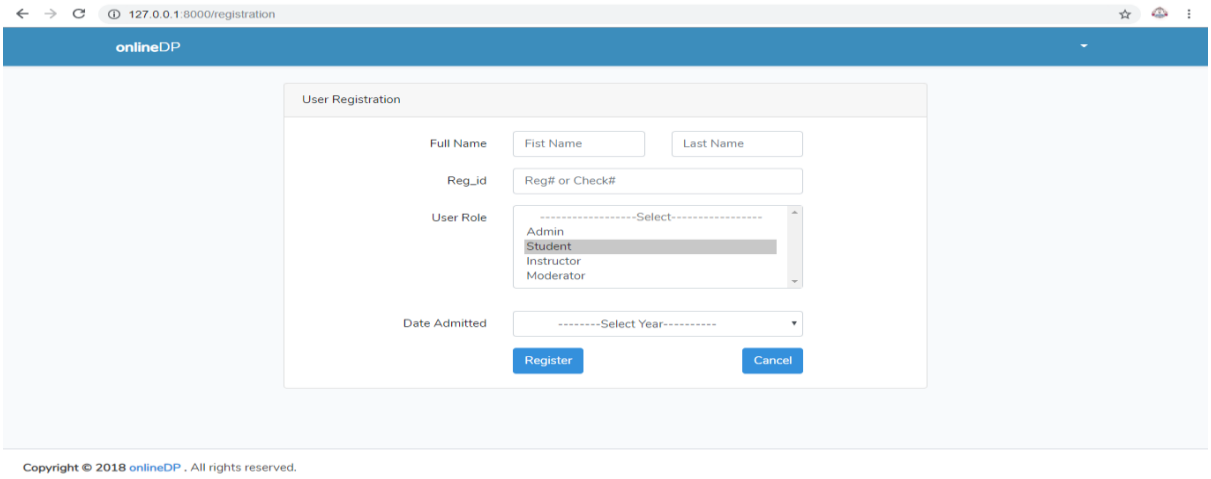


Figure 28: The onlineDP students' registration page

(ii) Login Page

The login page allows the user to type in their credentials for authentication to the system. Following the successful login, various users will have different access menus and subsequently various accesses to pages and links to perform various tasks under their roles.

When a user successfully logs into the system, it is directed to the homepage where will find different topics under discussion. This page in Fig. 31 has several tabs that allow the user to post a question, a task and visit the timeline. Additionally, there are several menus and links to other general-purpose tasks such as profile management.

(iii) Home Page

Following successful login, users will be redirected to the home page that shows any discussion contents over topics and the contributions from various contributors. The discussion topics is displayed in descending order with the latest post being displayed at the

top. This page was integrated with the Tiny Moxiecode Content Editor (tinyMCE), this a what you see is what you get (WYSIWYG) HTML editor to assist users to format their contents as well as to enable this page to render contents from html tags.

The home page is composed of four tabs, the home tab (Fig. 30) which displays the posted content. It displays the main post, comments, reaction over the post and the option to share the post to the social media. The post tab (Fig. 31) contains the tools to assist users to create and post contents/ question to the platform.

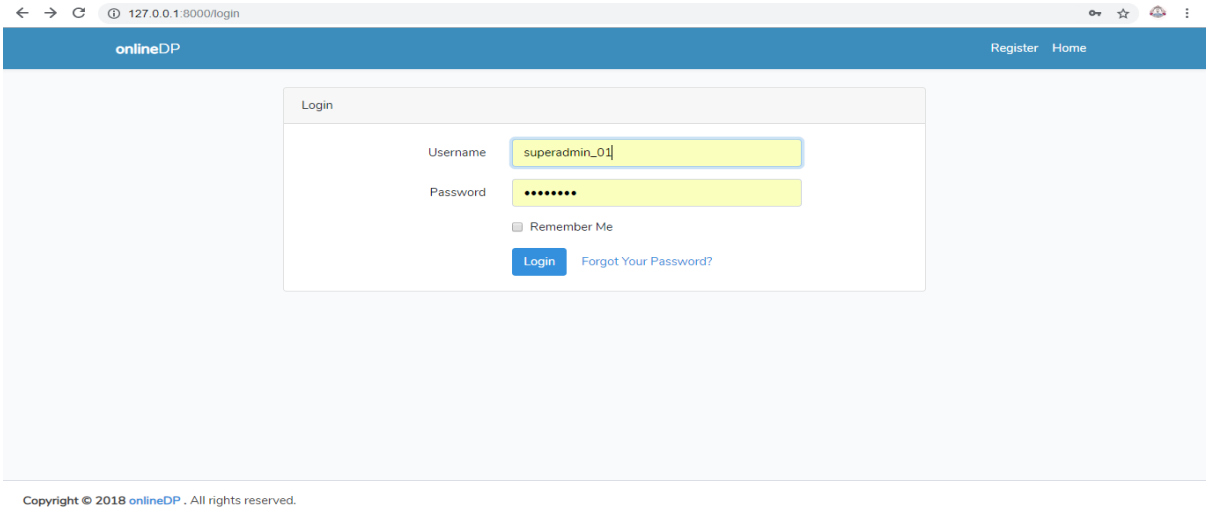


Figure 29: The onlineDP login page

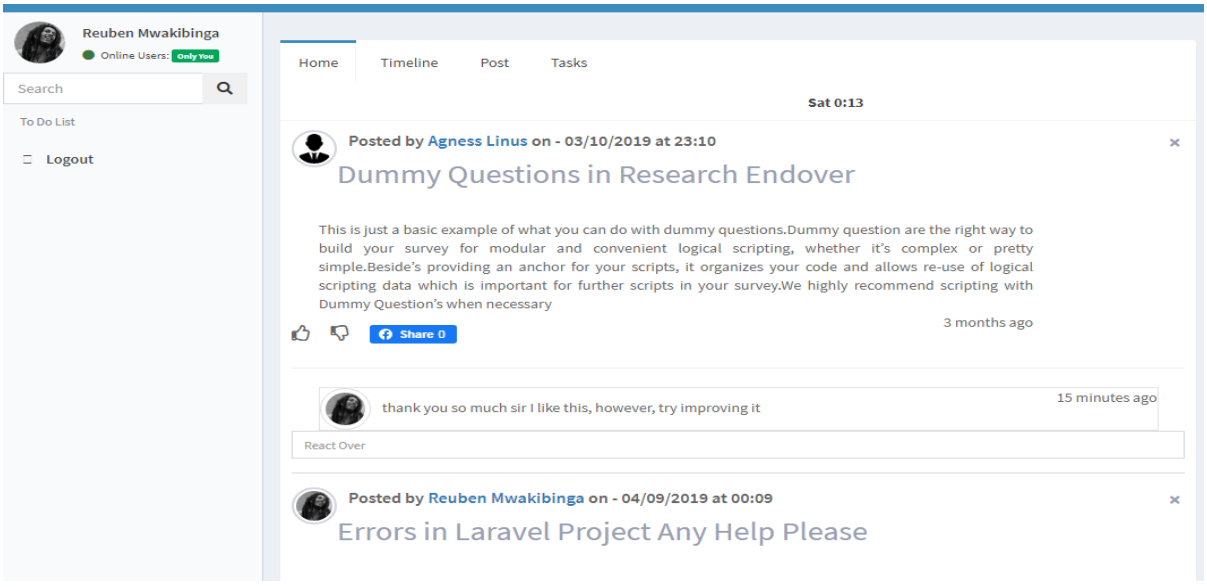


Figure 30: Home page for onlineDP

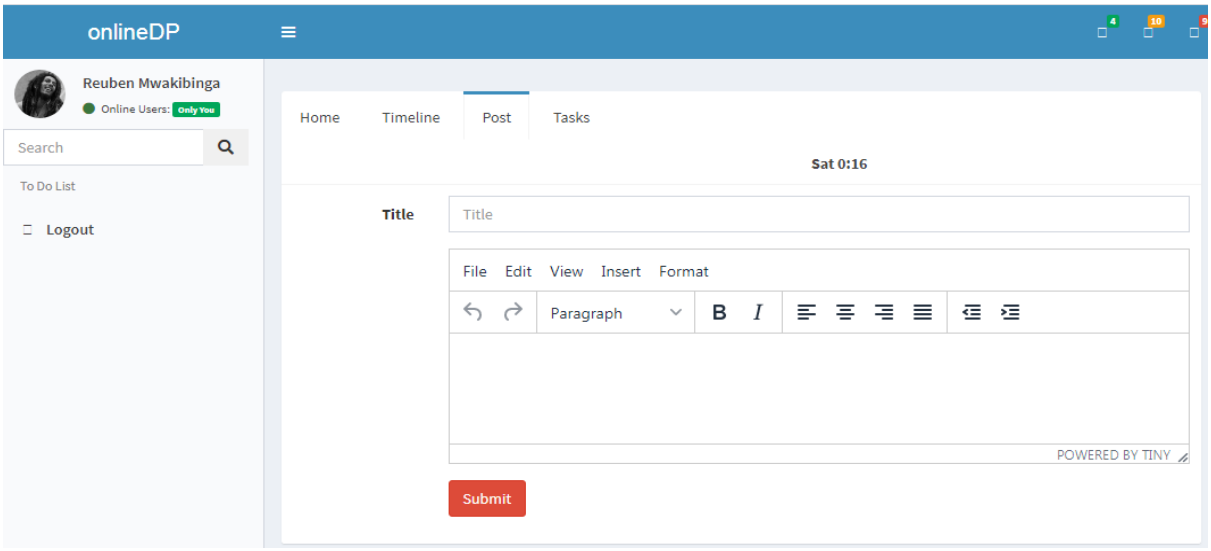


Figure 31: Post table in the onlineDP home page

The task tab (Fig. 32) which has options to assist users to create task and upload files to the system.

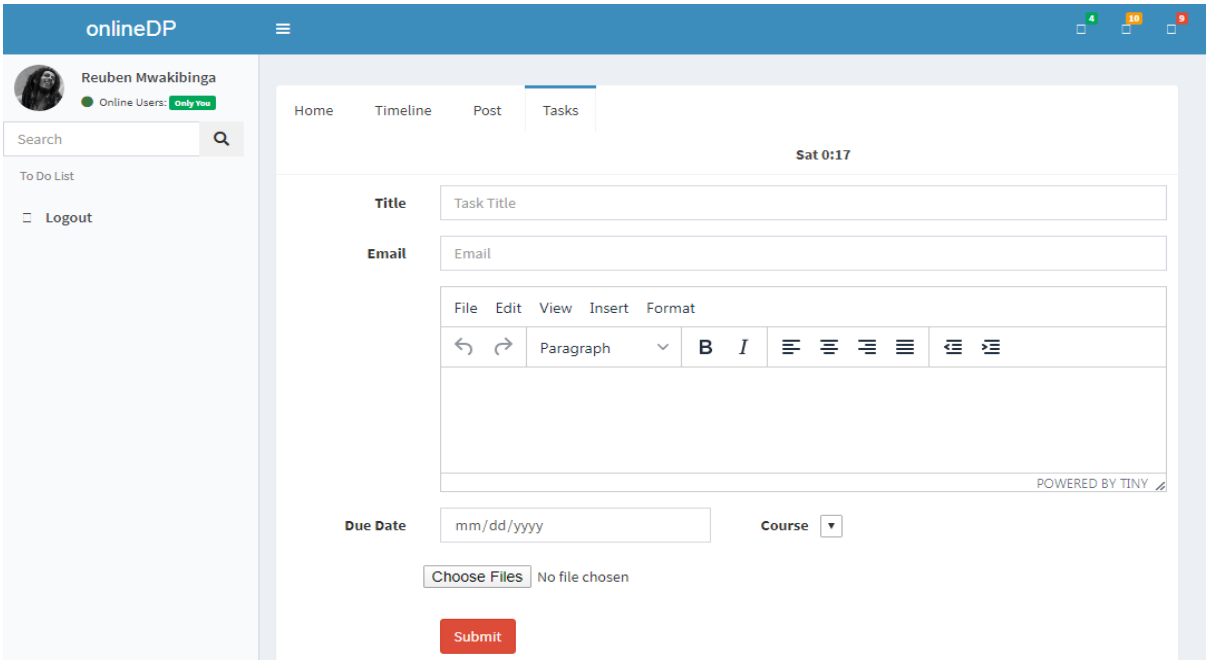


Figure 32: The task tab in onlineDP home page

4.7 System Testing

4.7.1 System Testing

The modules of the system were tested against the defined systems requirements to find if they worked as per definitions of the system's requirements. Table 16 indicates the test results.

Table 16: The onlineDP modules test results

System Requirement	Result
All users shall be registered by administrators and each user should be able to create and manage a profile.	PASS
Each user shall be allowed to change a password at any time.	PASS
The system shall allow users to initiate a discussion topic.	PASS
The system shall allow users to participate group discussion.	PASS
onlineDP shall semantically check for contents similarity before gets posted	PASS
The system shall allow the moderators to moderate posted contents before is publicly available	PASS
onlineDP system shall ensure that all users passwords are strongly hashed.	PASS
The System should authenticate all users before allowing them to interact with the system functionalities.	PASS
It should be able to add new menus, functionalities and features without any major redesign.	PASS

4.7.2 User's Acceptance

This study used allowed user to test the application independently without supervision. In this exercise 10 individuals were given access to the prototype and then they responded to questions asked via a Google form survey tool (Appendix 10). The survey toot involved six aspects for testing users experience the system; the user was required to rate each on the five point Likert scale (Strongly Agree (S.A)=5; Agree (A)=4; Not Sure (N.S)=3; Disagree (D.A)=2; Strongly Disagree (S.D.A)=5).

Table 17 presents the mean score of each application's; moreover, it indicates the mean application score from all aspects.

The users rated the desirableness with 2.40; this was the lowest rated aspect of the onlineDP. The accessibility followed with the average score of 3.00, then 3.10, 3.40 and 4.30 followed for credibility, valuable and usability aspects, respectively. On the other side, usefulness aspect was the high rated aspect with an average score of 4.7.

Ultimately, onlineDP was accepted by the users at an average of 3.48, this imply that majority of users accepted the prototype.

Table 17: Prototype acceptance results

Testing Aspect	Description	Number of Responses					Average score
		S.A	A	N.S	D.A	S.D.A	
Usefulness	Does onlineDP have a practical purpose?	7	3	0	0	0	**4.70**
Usability	Can the application be used for academic discussion purpose and easy?	3	7	0	0	0	**4.30**
Desirableness	How much has onlineDP included elements of emotional design?	0	0	5	4	1	**2.40**
Accessibility	How has the application included indicative texts and notification tips?	0	4	3	2	1	**3.00**
Credibility	How much can you trust the application?	2	1	4	2	1	**3.10**
Valuable	How can onlineDP improve your satisfaction?	1	5	2	1	1	**3.40**
Average score for application							**3.48**

4.8 Discussion

For this research to achieve its main objective it laid down three specific objectives. These objectives subsequently evolved into three research questions. It used a set of methodologies as indicated in chapter three seek the answers to the questions. Previous sections in this chapter have presented the answers; this section gives the discussion of the results following the three specific objectives of this study.

Following the first specific objective, which was to collect and analyze fundamental requirements for online academic discussion platform for students in HLIs.

This study found that students lived in different residences, the majority of students found to live off-campus and only a few lived on-campus; still, the students met for academic discussions; this was either physically or online using different platforms such as social media groups. Only a few met physically; and this may be due to inedibility of the public places for studies and discussions as reported in Istoroyekti (2016, p. 56).

Hence, the majority of them used to meet online. Thus it shows that there is a shift in the means of conducting discussions, from the traditional face-to-face approach to the new modern way using the ubiquitous active tools like discussion platforms in SNS.

This concurs with the prophetic view of Professor Bates in Simsek (2011) and indicates that students can learn socially in confined networks as it is pointed out in Jumaat and Tasir

(2016) which adheres to the contemporary digital age learning theory, connectivism learning. However, it was shown that use of these tools should not solely be achieving course objectives, rather the attention has as well be put to the theoretical underpinnings towards their implementations and teaching and learning tools as learning requires special seriousness (Eger, 2015; Tess, 2013).

Besides, this study reveals that students at this generation are digitally equipped. At least each student from the surveyed HLIs owns at least a single computing gadget, be it a mobile phone, tablet, or computer. Moreover, the majority of them frequently use the Internet and online platforms for different activities, however, only few who spent time on the Internet for academic issues.

Nonetheless, they complained of slow Internet speed, Internet data bundle costs, lack of moderations of sources in the online discussions and the times they spent in social networking, lack of awareness on how to use the tools etcetera. They reported issues concerned with the Internet, slow bandwidth speed; this concurs with what reported in Lwoga (2012) and Mtebe (2015).

Furthermore, in this study, it was revealed that the need for an online discussion platform (onlineDP) is for all students regardless of their residences. It shows that there is a significant positive correlation between the situation which students perceived when meeting for academic discussions and the way they recommended for an intervention, the onlineDP.

Finally, it found that among the three classes of discussion forums: auxiliary, hybrid and embedded hybrid was the category that leverages the rest. It supplements the face-to-face teaching and learning and delegates the mandates to both students and the instructors. It was adapted and ruled the process of requirement elicitation during the design of the onlineDP architecture to realize the proposed model into a full working discussion platform.

According to the second specific objective of this study, which to design and implement the online academic discussion platform for students in HLIs.

This study achieved to design an MVC application model that was implemented using the Laravel PHP framework, UMBC semantic similarity API, AdminLTE template and Font Awesome icons. The developed application can allow HLIs students to discuss and share the

knowledge between them and their course instructors in a more secure way and a confined network for students and course instructors.

According to the third specific objective; this was to validate the implementation of online academic discussion platform.

The developed system met its specifications; the majority among the users who tested found it valuable and useful for academic discussions.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study aimed to develop an online discussion platform for enhancing effective collaborative learning for students in HLIs in Tanzania. It firstly reviewed the existing web platforms used for discussion platforms, secondly assessed the computing devices ownership, the frequency of using the Internet and the usability of it in accessing any online discussion platform.

Additionally, it evaluated the situation faced by students when meeting for academic discussion especially after normal class hours and assessed factors that could affect students' recommendations of an online discussion platform.

Moreover, it established both functional and non-functional requirements for the online discussion platform which later used to design and implement the application.

This research found that at least each student at higher education owns a mobile computing gadget: mobile phone, tablet, or personal computer. It as well found that the students are good users of the Internet for their academic activities. However, they face challenges when using LMS and SNS for academic activities, for instance, they spend much more time on social networking than learning.

Eventually, it has revealed tremendous results from how both on-campus and off-campus students recommend the online discussion platform. They equivalently recommend it regardless of their residence.

This implies that there is a matured ICTs and Internet usage among students in HLIs and thus developing the online academic discussion platform to be used at higher leaning institutions that is responsive in all devices will maximize its usage.

5.2 Recommendations

The education stakeholders including the Tanzania Commission for Universities and HLIs should work on these findings and should adapt and use the onlineDP to sustain the challenges of small number of staff and insufficient public areas for academic issues in the Tanzanian higher education context where lecture halls have been the basic setting for T/L

with an annual increase of the students enrolment number. Additionally, to clear the challenge of using the LMS as repositories or social media that is against some universities' policy as the academic discussion arena.

The model proposed in this study should be made publicly known so that other researchers and software developers may know that when developing a platform that is meant for academic issues. They should consider the educational underpinnings and not the purposes it may serve in achieving the educational goals. As well it should consider the cybercrime legal frameworks in the academic institutions and at large that of the country.

Internet and network have an undoubted position towards the use of ICTs, though, speed is low and the cost of the Internet bundles is high; the costs for the bundles should be decreases to be affordable for a normal student. Consequently, the speed of Internet access should be increased across the HLIs environs.

This research recommends the future work to consider using machine learning algorithms and artificial intelligence to develop smart algorithms that will perform advances content moderation and recommendations and check and group similar contents semantically.

REFERENCES

Abawajy, J., & Kim, T. (2011). Online Learning Environment: Taxonomy of Asynchronous Online Discussion Forums. *Springer-Verlag Berlin Heidelberg*, *257*, 706–714. https://doi.org/10.1007/978-3-642-27207-3_75

Abrahim, S., Mir, B. A., Suhara, H., & Sato, M. (2018). Exploring Academic Use of Online Social Networking Sites (SNS) for Language Learning: Japanese Students' Perceptions and Attitudes Towards Facebook. *Journal of Information Technology & Software Engineering*, *8*(1), 4–9. https://doi.org/10.4172/2165-7866.1000223

Al-Abri, A., Jamoussi, Y., Kraiem, N., & Al-Khanjari, Z. (2017). Comprehensive classification of collaboration approaches in E-learning. *Telematics and Informatics, 34* (6), 878–893. https://doi.org/10.1016/j.tele.2016.08.006

Alan, D., Wixom, B. H., & Tegarden, D. (2015). *Systems Analysis & Design An Object-Oriented Approach with UML* (5th ed.). New York: John Wiley & Sons, Inc.

Alqahtani, S., & Issa, T. (2018). Barriers to the adoption of social networking sites in Saudi Arabia's higher education. *Behaviour & Information Technology*, *37*(3), 1–11. https://doi.org/10.1080/0144929X.2018.1464600

Alwi, N. H. M., Mahir, N. A., & Ismail, S. (2014). Infusing Social Media in Teaching and Learning (TnL) at Tertiary Institutions: A Case of Effective Communication in Universiti Sains Islam Malaysia (USIM). *Procedia - Social and Behavioral Sciences*, *155*(2014), 265–270. https://doi.org/10.1016/j.sbspro.2014.10.290

Ammann, P., & Offutt, J. (2008). *Introduction to SoftwareTesting* (Vol. 39). New York: Cambridge University Press.

Association for Educational Communications and Technology. (2004). *Definition of Educational Technology*.

Athuraliya, A. (2019). Sequence Diagram Tutorial: Complete Guide with Examples. Retrieved 7 November 2019, from https://creately.com/blog/diagrams/sequence-diagram-tutorial/

Bagarukayo, E., & Kalema, B. (2015). Evaluation of elearning usage in South African universities: A critical review. *International Journal of Education and Development*

Using Information and Communication Technology, *11*(2), 168–183.

Banerjee, A., & Chaudhury, S. (2010). Statistics without tears: Populations and samples. *Industrial Psychiatry Journal*, *19*(1), 60–65. https://doi.org/10.4103/0972-6748.77642

Bean, M. (2015). *Laravel 5 Essentials*. Birmingham: Packt Publishing Ltd.

Bhalalusesa, R., Lukwaro, E. E., & Clemence, M. (2013). Challenges of Using E-learning Management Systems faced by the Academic Staff in Distance Based Institutions from Developing Countries: A case Study of the Open University of Tanzania. *Huria: Journal of the Open University of Tanzania*, *14*(1), 89–110.

Blank, G., & Reisdorf, B. C. (2012). The Participatory Web: A user perspective on Web 2.0. *Information Communication and Society*, *15*(4), 537–554. https://doi.org/10.1080/1369118X.2012.665935

Bohley, K. A. (2010). Web 2.0: What Is It And Is It For Me? *Information, Communication & Society*, *3*(7), 7–10. https://doi.org/10.19030/ajbe.v3i7.453

Brindley, J. E., Walti, C., & Blaschke, L. M. (2009). Creating Effective Collaborative Learning Groups in an Online Environment Brindley The International Review of Research in Open and Distance Learning. *International Review of Research in Open and Distance Learning*, *10*(3), 1–18.

Burgueño, L., Vallecillo, A., & Gogolla, M. (2018). Teaching UML and OCL models and their validation to software engineering students: an experience report. *Computer Science Education*, *28*(1), 23–41. https://doi.org/10.1080/08993408.2018.1462000

Cassell, C., Cunliffe, A. L., & Grandy, G. (2018). Qualitative Business and Management Research Methods. In *Animal Genetics* (Vol. 39). London: SAGE Publications Ltd.

Centers for Disease Control and Prevention. (2009). *Data Collection Methods for Evaluation: Document Review*.

Christian, F., & Sandoval, M. (2014). *Critique, Social Media and the Information Society*. New York: Taylor and Francis Group, LLC.

Clark, C. (2010). Definitions of Educational Technology[Updated]. Retrieved 28 October 2017, from https://ltlatnd.wordpress.com/2010/09/17/definition-of-educational-tech

nology/

Creswell, W. J. (2012). *Educational Research* (4th ed.). New York: Pearson Education, Inc.

Development Institute Overseas. (2016). *Case study : Arusha*. London.

Dhamdhere, S. N. (2011). ABCD, an Open Source Software for Modern Libraries. *Chinese Librarianship*, *32*(32), 1–17.

Edquist, H. (2017). New report proves mobile broadband drives global economic development. Retrieved 24 October 2018, from https://www.ericsson.com/the company /sustainability_corporateresponsibility/technology-for-good-blog/2017/09/14/4524/

Eger, L. (2015). Is Facebook a Similar Learning Tool for University Students as LMS? *Procedia - Social and Behavioral Sciences*, *203*(2015), 233–238. https://doi.org/ 10.1016/j.sbspro.2015.08.287

Etikan, I., Alkassim, R., & Abubakar, S. (2016). Comparision of Snowball Sampling and Sequential Sampling Technique. *Biometrics & Biostatistics International Journal*, *3*(1), 1–2. https://doi.org/10.15406/bbij.2016.03.00055

Ghuman, S. S. (2014). Software Testing Techniques. *International Journal of Computer Science and Mobile Computing*, *3*(10), 988–993.

Han, L., Kashyap, A., Finin, T., Mayfield, J., & Weese, J. (2013). UMBC_EBIQUITY-CORE: Semantic Textual Similarity Systems. *Proceedings of the 2nd Joint Conference on Lexical and Computational Semantics*, *1*, 44–52.

Istoroyekti, Y. M. (2016). Issues Challenging Universities: A Case of Tanzanian Higher Education. *Ahmad Dahlan Journal of English Studies*, *3*(1), 51–62. https://doi.org/ 10.26555/adjes.v3i1.3625

John K, M. (2015). Sustainable Concrete Made From Recycled Aggregates. *BAM Federal Institute for Materials Research and Testing*, 57–62.

John, L., & Sam, A. E. (2018). An Online Collaborative Discussion Platform for Bridging a Technological Reliance Gap in Higher Learning Institutions in Tanzania. *International Journal of Modern Education and Computer Science*, *10*(11), 29–35. https://doi.org/ 10.5815/ijmecs. 2018.11.04

Johnson, S. L., Willis, L. H., & Haywood, K. (2011). *The Horizon Report*. Austin, Texas.

Jumaat, N. F., & Tasir, Z. (2016). Facebook as a Platform for Academic-Related Discussion and Its Impact on Students Success. *Institute of Electrical and Electronics Engineers*, 1–6.

Kelley, P. (2016). Documents that Changed the World: Sir Ronald Fisher defines 'statistical significance,' 1925. Retrieved 16 December 2019, from https://www.washington.edu/news/2016/12/21/documents-that-changed-the-world-sir-ronald-fisher-defines-statistical-significance-1925/

Kendall, K. E., & Kendall, J. E. (2011). *Systems Analysis and Design* (9th ed.). New York: Pearson Education, Inc.

Kovalcikova, I., & Petrucijova, J. (2013). An international academic discussion platform as a means of identity building for university; students' opinions about the advantages and disadvantages of EU membership. *Identities and Citizenship Education: Controversy, Crisis and Challenges*, 42–52.

Kozma, R. B. (2008). Comparative Analysis of Policies for ICT in Education. *International Handbook of Information Technology in Primary and Secondary Education*, 1083–1096.

Lwoga, E. (2012). Making Learning and Web 2.0 Technologies Work for Higher Learning Institutions in Africa. *Campus-Wide Information Systems*, *29*(2), 90–107. https://doi.org/10.1108/10650741211212359

Mahbub, R. (2016). Exploring the Use of "I-Learn" Platform for Multi-Disciplinary Teaching of Built Environment Programs. *Proceedings of Education and New Learning 16 Conference*, 4630–4636.

Mbawala, B. M. (2017). *An Assessment of the Implementation of Fee Free Basic Education in Tanzania: A Case of Ruangwa District's District Council, Lindi Region*. The Open University of Tanzania.

Merchant, G. (2009). Web 2.0, New Literacies, and the Idea of Learning through Participation. *English Teaching: Practice and Critique*, *8*(3), 107–122.

Moran, M., Seaman, J., & Tinti-Kane, H. (2011). *Teaching, Learning, and Sharing: How Today's Higher Education Faculty Use Social Media*. Pearson Learning Solutions and

Babson Survey Research Group.

Mtebe, J. S. (2015). Learning Management System success: Increasing Learning Management System usage in Higher Education in Sub-Saharan Africa. *International Journal of Education and Development Using Information and Communication Technology*, *11*(2), 51–64.

Mtebe, J. S., & Kondoro, A. W. (2016). Using Mobile Moodle to enhance Moodle LMS accessibility and usage at the University of Dar es Salaam. *IST-Africa 2016 Conference Proceedings*, 1–11.

Mtebe, J. S., & Raisamo, R. (2014). Challenges and Instructors' Intention to Adopt and Use Open Educational Research in Higher Education. *The International Review of Research in Open and Distance Learning*, *15*(1), 249–271.

Mtebe, J. S., & Raphael, C. (2017). A Decade of Technology Enhanced Learning at the University of Dar es Salaam, Tanzania: Challenges, Achievements, and Opportunities. *International Journal of Education and Development Using Information and Communication Technology*, *13*(2), 103–115.

Murgor, T. K. (2015). Challenges Facing Adoption of Information Communication Technology in African Universities. *Journal of Education and Practice*, *6*(25), 62–69.

Myers, M. D., & Avison, D. (2002). *Qualitative Research in Inofrmation Systems A Reader*. London: SAGE Publications Ltd.

National Council of Educational Research and Training. (2006). *National Focus Group on Educational Technology*. New Delhi: National Council of Educational Research and Training.

Neill, J. (2009). Connectivism. Retrieved 19 October 2018, from https://en.wikiversity.org /wiki/Connectivism

Noor-Ul-Amin, S. (2013). An Effective use of ICT for Education and Learning by Drawing on Worldwide Knowledge, Research and Experience: ICT as a Change Agent for Education (A Literature Review). *Scholarly Journal of Education*, *2*(4), 38–45.

O'Reilly, T. (2005). What Is Web 2.0 Design Patterns and Business Models for the Next Generation of Software. Retrieved 29 October 2018, from https://www.oreilly.com

/pub/a/web2/archive/what-is-web-20.html

Oyelere, S. S., Paliktzoglou, V., & Suhonen, J. (2016). M-learning in Nigerian higher education: an experimental study with Edmodo. *International Journal of Social Media and Interactive Learning Environments*, *4*(1), 43–62. https://doi.org/10.1504/IJSMILE.2016.075055

Pegg, K. J., O'Donnell, A. W., Lala, G., & Barber, B. L. (2018). The Role of Online Social Identity in the Relationship between Alcohol-Related Content on Social Networking Sites and Adolescent Alcohol Use. *Cyberpsychology, Behavior, and Social Networking*, *21*(1), 50–55. https://doi.org/10.1089/cyber.2016.0665

Relivingmbadays. (2013). Research Design: Meaning and Importance. Retrieved 2 November 2019, from https://relivingmbadays.wordpress.com/2013/05/15/research-design-meaning-and-importance/

Right to Education. (2016). Tanzania Implements Free Education Policy For Secondary Education. Retrieved 26 October 2018, from http://www.right-to-education.org/news/tanzania-implements-free-education-policy-secondary-education

Rivers, J. K., Rivers, P. A., & Hazell, V. (2015). Africa and Technology in Higher Education : Trends , Challenges , and Promise. *International Journal for Innovation*, *3* (5), 14–31.

Robi, A. (2016). Tanzania: Free Education - a Noble Initiative. Retrieved 26 October 2018, from https://allafrica.com/stories/201601270691.html

Romero, C., López, M. I., Luna, J. M., & Ventura, S. (2013). Predicting Students' Final Performance from Participation in On-line Discussion Forums. *Computers and Education*, *68*(2013), 458–472. https://doi.org/10.1016/j.compedu.2013.06.009

Sandin, E. V., Yassin, N. M., & Mohamad, R. (2016). Comparative Evaluation of Automated Unit Testing Tool for PHP. *International Journal of Software Engineering and Technology*, *3*(2), 7–11.

Satzinger, J. W., Jackson, R. B., & Burd, S. D. (2012). *System Analysis and Design in a Changing World* (6th ed.). Boston: Course Technology.

Saunders, M., Lewis, P., & Thornhill, A. (2016). *Research Methods for Business Students* (7th

ed.). London: Pearson.

Saunier, R. (2014). *Getting Started with Laravel 4*. Birmingham: Packt Publishing Ltd.

Schoonenboom, J., & Johnson, R. B. (2017). How to Construct a Mixed Methods Research Design. *Kolner Zeitschrift Fur Soziologie Und Sozialpsychologie*, *69*(2), 107–131. https://doi.org/10.1007/s11577-017-0454-1

Sekar, G. D., Kumar, N. H., & Gowtham, P. (2018). College Time Table Management System using Android Application. *International Journal of Scientific Research in Computer Science, Engineering and Information Technology*, *3*(4), 414–418.

Selwyn, N. (2007). The use of Computer Technology in University Teaching and Learning: A critical Perspective. *Journal of Computer Assisted Learning*, *23*(2), 83–94. https://doi.org/10.1111/j.1365-2729.2006.00204.x

Shan, J. F. (2013). ICT in Education : A Critical Literature Review and Its Implications. *International Journal of Education and Development Using Information and Communication Technology*, *9*(1), 112–125.

Siemens, G. (2005). Connectivism: A Learning Theory for the Digital Age. Retrieved 19 October 2018, from http://www.itdl.org/journal/jan_05/article01.htm

Sife, A. S., Lwoga, E., & Sanga, C. (2007). How to determine your readiness for mobile e-learning. Information policy. *International Journal of Education and Development Using Information and Communication Technology*, *3*(2), 57–67.

Simsek, A. (2011). Interview with Tony Bates on the Aspects and Prospects of Online Learning. *Contemporary Educational Technology*, *2*(1), 88–94.

Sinha, S. (2017). *Beginning Laravel*. New York: Springer Science+Business Media.

SlideShare. (2012). Educational Technology vs Technology in Education. Retrieved 20 October 2018, from https://www.slideshare.net/jmmendoza21/ed-tech-14680002

Smith, S. M. (2013). *Determining Sample Size How to Ensure You Get the Correct Sample Size*.

Sommerville, I. (2011). *Software Engineering* (9th ed.). New York: Pearson Education, Inc.

Spector, J. M. (2013). Emerging Educational Technologies and Research Directions. *Educational Technology and Society*, *16*(2), 21–30.

Tanzania Commission for Universities. (2016). *Tanzania Commission for Universities List of University Institutions in Tanzania as of 22nd February, 2016*. Tanzania Commission for Universities.

Tanzania Commission for Universities. (2018). *List of Undergraduate Degree Programmes Approved to Admit Students in 2018/2019 Academic Year*. Dar es Salaam: Tanzania Commission for Universities.

Tanzania Communication Regulatory Authority. (2019). *Quarterly Communications Statistics April-June 2019 Operators ' Submissions*.

Teddlie, C., & yu, F. (2007). Mixed Methods Sampling: A Typology With Examples. *Journal of Mixed Methods Research*, *1*(1), 77–100. https://doi.org/10.1177/2345678906292430

Tess, P. A. (2013). The role of Social Media in Higher Education Classes (Real and Virtual)- A Literature Review. *Computers in Human Behavior*, *29*(2013), A60–A68. https://doi.org/10.1016/j.chb.2012.12.032

Thongmak, M. (2013). Social Network System in Classroom: Antecedents of Edmodo © Adoption. *Journal of E-Learning and Higher Education*, *2013*, 1–15. https://doi.org/10.5171/2013.657749

Trottier, D., & Christian, F. (2014). An Introduction. In *Theorising Social Media, Politics and the State* (pp. 3–38). New York: Taylor & Francis Group.

UNESCO. (2015). *Digital Services for Education in Africa*.

URT. (2016). *Basic education statistics in tanzania (BEST) 2012-2016*. Dar es Salaam.

V.Rasiah, R. R. (2014). Transformative Higher Education Teaching and Learning: Using Social Media in a Team-based Learning Environment. *Procedia - Social and Behavioral Sciences*, *123*(2014), 369–379. https://doi.org/10.1016/j.sbspro.2014.01.1435

Wang, M. (2013). *The Oxford Handbook of Retirement*. New York: Oxford University Press.

Yin, R. K. (2016). *Qualitative Research from Start to Finish* (2nd ed.). New York: The Guilford Press.

Zdravkova, K. (2016). Reinforcing Social Media Based Learning, Knowledge Acquisition and Learning Evaluation. *Procedia - Social and Behavioral Sciences*, *228*(2016), 16–23. https://doi.org/10.1016/j.sbspro.2016.07.003

APPENDICES

Appendix 1: Introduction letter for information gathering

THE NELSON MANDELA
AFRICAN INSTITUTION OF SCIENCE AND TECHNOLOGY
(NM-AIST)
School of Computational and Communication Science and Engineering

Direct Line: +255 272970001
Fax: +255 272970016
E-mail: dean-cocse@nm-aist.ac.tz

Tengeru
P.O. Box 447
Arusha, TANZANIA
Website: www.nm- aist.ac.tz

OUR Ref. No. NM-AIST/M.307/T.16 **Date:** 2nd May, 2018

To Whom It May Concern,

Dear Sir/Madam,

RE: INTRODUCTION TO LINUS JOHN

Kindly refer to the above heading.

I wish to introduce Linus John with Registration No. NM-AIST/M.307 who is a Masters student at Nelson Mandela African Institution of Science and Technology, School of Computational and Communication Science and Engineering. As part of the requirement for Master's degree, Linus is undertaking a research with title **" An Online Academic Discussion Platform for Effective Collaborative Learning Environment in Higher Learning Institutions in Tanzania"**

In order to accomplish the research objectives, he would like to collect some information from your Institution/Organization. The information collected will be used only for research purposes and will give a picture on the issue of **"Effective Collaborative Learning Environment"** Application in Tanzania as it stats in the research objectives.

It is my sincere hope you will assist the student in accomplishing his study.

Looking forward to your cooperation.

Yours Sincerely,

Shubi Kaijage, *PhD*
Ag. Dean

Appendix 2: Cover letter for seeking data collection permission

Linus John,
The Nelson Mandela African Institution
of Science and Technology,
P. O. Box 447,
Tengeru, Arusha, Tanzania
May 14, 2018.

Registrar's Office,
P. O. Box 7,
Usa-River, Arusha.

RE: REQUEST FOR ONLINE ACADEMIC DISCUSSION APPLICATION REQUIREMENTS GATHERING

The heading of this letter is so concerned;

I am a second year Masters student at The Nelson Mandela African Institution of Science and Technology (NM-AIST), carrying a research on "**An online Academic Discussion Platform for Effective collaborative Learning Environment in Higher Learning Institutions in Tanzania**".

I hereby, write to request your esteemed office to grant to me the permission to collect the online collaborative discussion application/platform requirements at **University of Arusha**. I would like to meet and distribute my questionnaires hereto attached with this letter to the students and staff (IT and academic staff).

With this letter I have as well attached the research introductory letter from **NM-AIST**.

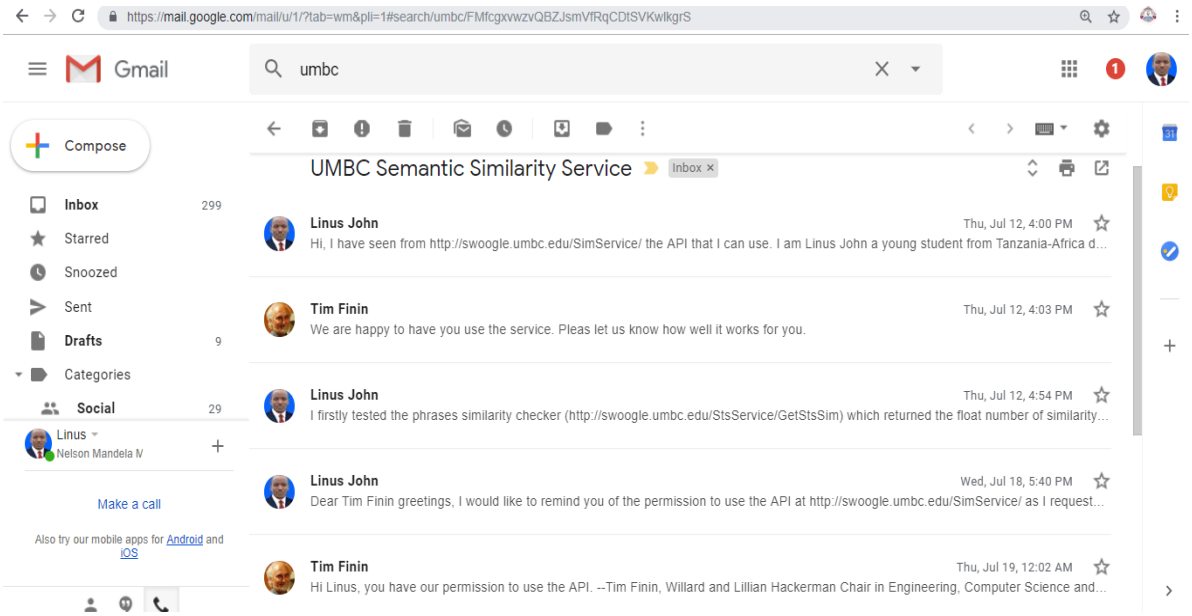
It is with honor and hope that I expect your urgent grant towards my request.

Yours sincerely,

Linus John
+255767834512
johnl@nm-aist.ac.tz

Mr. Elias Mbuki (Director) UoA- Town extension.
Endorsed to undertake the exercise at UoA- Town Campus extension
14/05/2018
0679008138

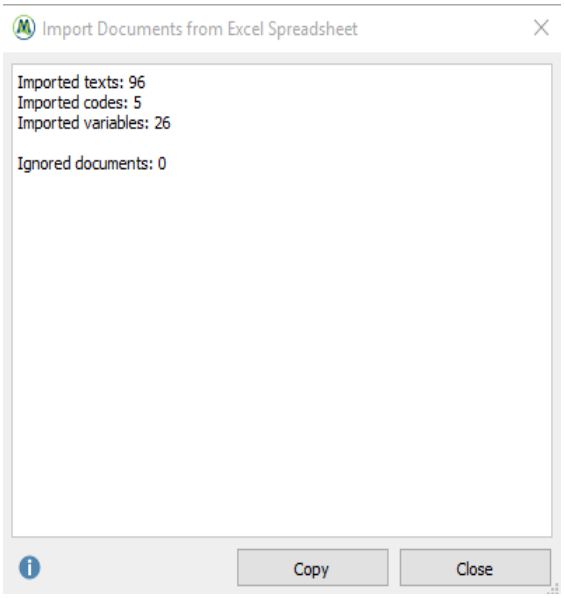
Appendix 3: Email conversation with Prof. Tim from UMBC



Appendix 4: Excel formula used to separated multiple values in a cell

```
=IF(ISNUMBER(SEARCH("key",celln)),IF(ISNUMBER(MID(celln,SEARCH("deimiter",celln)+1,SEARCH("delimiter",celln,SEARCH("delimiter",celln)+1)-SEARCH("delimiter",celln)-1)),"","value"),"")
```

Appendix 5: The summary of dataset importation in Maxqda



Appendix 6: List of variables and codes as used

Full Variable Name	Variable	Coding Instruction
Gender	GENDER	1=female; 2=male
Age	AGE	1=Below 20; 2=21-30; 3=31-40 ;4=41-50; 5=above 50
Higher Learning Institution	HLI	1=ATC; 2=IAA; 3=NM-AIST; 4=TUMA; 5=UoA
Respondent residence	RESIDENCE	1=on-campus; 2=off-Campus
Computing device ownership	COMP_DEV	5 for each
Device used to access Internet	DEV4INTERN	6 for each
Internet connectivity	INTERN_CONNECTIVITY	1=Yes;2=No;3=Limited
Internet Accessibility	INTERN_ACCESSIBILITY	1=Yes;2=No,
Internet Speed	INTE_RATE	1=Low;2=Moderate;3=Fast;4=Very Fast
Frequency of Using Internet	INTERN_FREQUENCY	0=Never;2=Sometimes;4=Often;6=Usually;7=Always
Learning activities on Internet	ACTIVITY_ON_INTERN	11 for each
Connection Device	DEV4CONN	12 for each
Know LMS	KNOW_LMS	13 for each
LMS used by Institutions	USED_LMS	14 for each
Ever used LMS	EVER_USED_LMS	1=Yes;2=No
Used LMS by Respondents	LMS_USED	16 for each
SM used	SM_USED	18 for each
Activities on SM	SM_ACTIVITY	19 for each
SM features often used	SM_FEATURES	20 for each
How discussion is onducted	HOW_DISCUSSION	22 for each
Meeting situation for iscussion	MEETING_SITUATION	1=Normal;2=Difficult;3=Very Difficult;4=Extremly Difficult
Know online discussion platforms	KNOW_ONDP	1=Yes;2=No
Online discussion platform known	ODP_KNOWN	25 for each
Online discussion platform used	ODP_USED	26 for each
online discussion platform can be a solution	ODP_SOL	1=Yes;2=No
Online discussion platform recommendation	ODP_RECOMM	1= Fairly Recommend; 2=Normally Recommend; 3=Strongly Recommend

Appendix 7: A survey questionnaire used during data collection

Introduction:

I am **Linus John**, pursuing Master's in Information Communication Science and Engineering at The Nelson Mandela African Institution of Science and Technology (NM-AIST). Meanwhile, I am conducting a study on "*Online Academic Discussion Platforms for Effective Collaborative Learning in Higher Learning Institutions in Tanzania.*" This questionnaire aims at gathering information that will give a picture on the recommendation of the online discussion platform as an Effective Collaborative Learning Environment in Tanzania. Thank you for your generosity to help in this study.

(Check [✓] the appropriate box)

Section A: Demographic Information

1. What is your Gender?
   i. Female ☐
   ii. Male ☐
2. How old are you?
   i. Below 20 ☐
   ii. 21-30 ☐
   iii. 31-40 ☐
   iv. 41-50 ☐
   v. Above 50 ☐
3. What is your Higher Learning Institution?
   i. ATC ☐
   ii. IAA ☐
   iii. NM-AIST ☐
   iv. TUMA ☐
   v. UoA ☐
   vi. If any other, specify……..
4. What is your residence at the Institution?
   i. On-Campus ☐ ii. Off-Campus ☐

SECTION B: Internet and Computing Devices ownership and Knowledge

5. Which computing device do you own?
   i. Mobile Phone ☐
   ii. Tablet ☐
   iii. PC-Personal Computer ☐
   iv. If any other, specify…….....
6. Which device do you use to access the Internet?
   i. Mobile Phone ☐
   ii. Tablet ☐
   iii. PC-Personal Computer ☐
7. Is there Internet connectivity at you campus?

i. Yes ☐ ii. No ☐

8. If Yes in 7 above, is it accessible at every point in the campus?
   i. Yes ☐ ii. No ☐ iii. Limited ☐

9. How would you rate the access speed of your campus Internet?
   i. Low ☐ ii. Moderate ☐ iii. Fast ☐ iv. Very Fast ☐

10. How do you often use Internet for your studies?
   i. Never ☐
   ii. Sometimes ☐
   iii. Often ☐
   iv. Usually ☐
   v. Always ☐

11. What learning activities do you normally do on Internet?
   i. Download Learning Material ☐
   ii. Share/Upload Learning Materials ☐
   iii. Read Notes ☐
   iv. Access articles ☐
   v. Access video tutorials ☐
   vi. If any other, specify ……...

12. How do you connect to the Internet outside the campus?
   i. Modem ☐ ii. Mobile ☐

SECTION C: Learning Management Systems (LMS) and Social Media awareness and use

13. What Learning Management System(s) do you know?
   i. Moodle ☐
   ii. Blackboard ☐Not that we write on in the classroom
   iii. Sakai ☐
   iv. WebCT ☐
   v. If any other, specify ……...
   vi. None ☐

14. Which Learning Management System does your Institution use?
   i. Moodle ☐
   ii. Blackboard ☐Not that we write on in the classroom
   iii. Sakai ☐
   iv. WebCT ☐
   v. If any other, specify ……...
   vi. I don't know ☐

15. Have you ever used any Learning Management System(s)?
   i. Yes ☐ ii. No ☐

16. If yes in 15 above, what did you use it for?
   i. Accessing course materials ☐
   ii. Sharing course materials ☐

iii. Discussion and Collaboration ☐

iv. Doing Assignment ☐

v. If any other, specify ……...

17. Mention any challenge(s) faced when using the Learning Management System(s)?

i. ……

ii. ……

iii. ……

18. Which social media are you currently using?

i. Facebook ☐

ii. You Tube ☐

iii. Instagram ☐

iv. Whatsapp ☐

v. Twitter ☐

vi. Telegram ☐

vii. If any other, specify.....

viii. I don't use social Media ☐

19. What do you normally use the social media for?

i. Chatting ☐

ii. Academic issues ☐

iii. Getting news ☐

iv. Posting news ☐

v. Sharing news ☐

vi. If any other, specify ……...

20. Which social media feature (s) do you often use?

i. Like ☐

ii. Upload ☐

iii. Comment ☐

iv. share ☐

v. post ☐

vi. If any other, specify……

21. If you have ever used any social media for academic issues; mention any challenge(s) you faced.

i. ……

ii. ……

iii. ……

iv. ……

v. ……

Section D: Discussion Environments and Discussion Platforms

22. How do you conduct the discussions at your institution?

i. face-to-face ☐

ii. online ☐

iii. If any other, specify …….

23. How is the situation during meeting for group discussion after normal class hours for on-campus and off-campus student?
    i. Normal ☐
    ii. Difficult ☐
    iii. Very difficult ☐
    iv. Extremely difficulty ☐
24. Do you know if there exist any online discussion platforms?
    i. Yes ☐ ii. No ☐
25. If yes in 25 above, which online discussion platform do you know?
    i. Canvas ☐
    ii. Moodle ☐
    iii. Edmodo ☐
    iv. Sakai ☐
    v. Schoology ☐
    vi. Showbie ☐
    vii. iTunes U ☐
    vii. Google Classroom ☐
    viii. Stackoverflow ☐
    ix. ShuleDirect ☐
    x. Editage Insights ☐
    xi. Social Media Groups ☐
    xii. If any other, specify …….
26. Which online discussion platform have you ever used for academic discussion?
    i. Canvas ☐
    ii. Moodle ☐
    iii. Edmodo ☐
    iv. Schoology ☐
    v. Sakai ☐
    vi. Showbie ☐
    vii. iTunes U ☐
    viii. Google Classroom ☐
    viii. Stackoverflow ☐
    ix. Editage Insights ☐
    x. ShuleDirect ☐
    xi. Social Media Groups ☐
    xii. If any other, specify ……...
    xiii. I don't use any ☐
27. Mention if any challenge(s) faced when using the online discussion platform(s) above for academic discussions.
    i. ……
    ii. ……
    iii. ……

28. If the situation in 23 is at least difficult, do you think that an online discussion platform can be a solution to it?
    i. Yes ☐ ii No ☐
29. How would you recommend for an online discussion group platform in your learning?
    i. Fairly Recommend☐
    ii. Normally Recommend☐
    iii. Strongly Recommend☐

Section E: Self Opinion on Internet and Online discussion platforms.

30. In your own arguments may you tell us how the Internet is contributing to your studies?
    i. ……
    ii. ……
    iii. ……
31. If you recommend the online discussion group platform; what are the services would you like to receive from it?
    i. ……
    ii. ……
    iii. ……
    iv. ……

Key Terms:

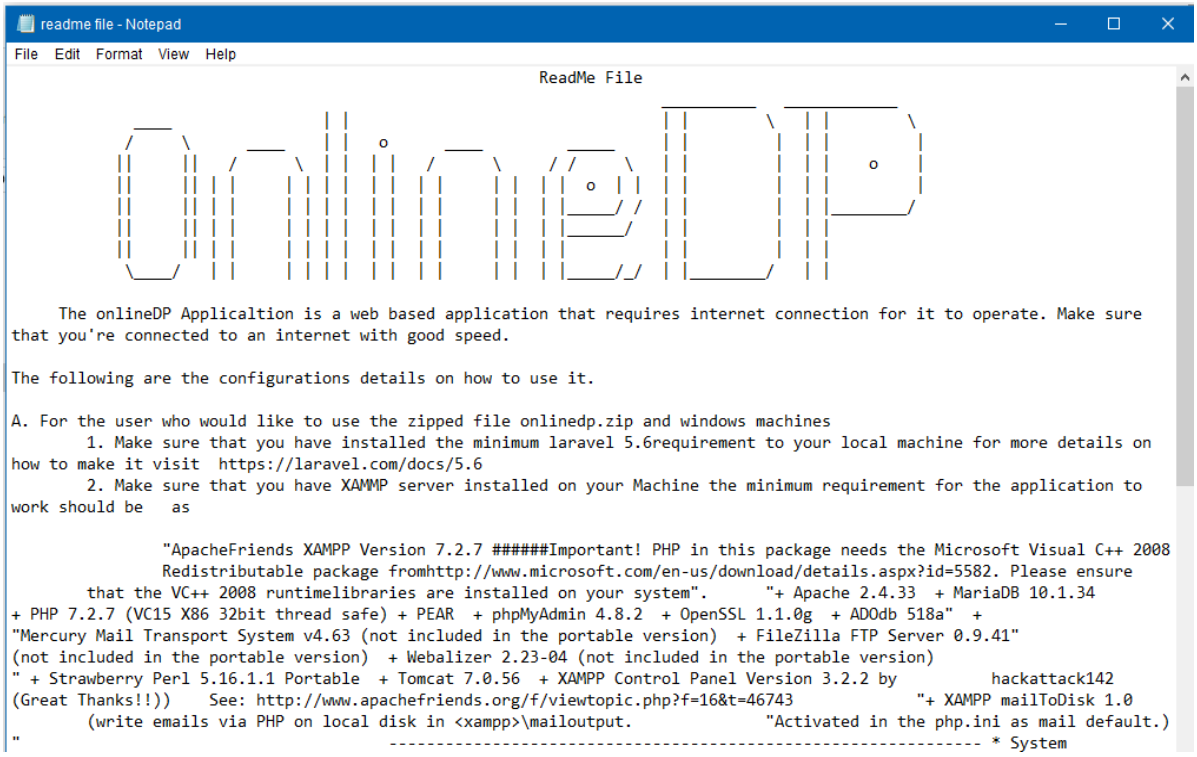
1. **Learning management system (LMS)** is a software application for the administration, documentation, tracking, reporting and delivery of educational courses or training programs.
2. **Online discussion platform** is an online platform that allows for, or is built specifically for, online discussion.

Appendix 8: Migration class to create user roles

```
<?php
/*this file creates the last table in the database migration
After that it automates the creation of the super user who will be able
to create other users of the onlineDP
*/
use Illuminate\Support\Facades\Schema;
use Illuminate\Database\Schema\Blueprint;
use Illuminate\Database\Migrations\Migration;
use App\Menu;
use App\Role;
use App\User;
use App\Person;
class CreateRoleUserTable extends Migration
{
    /**
     * Run the migrations.
     *
     * @return void
     */
    public function up()
    {
        Schema::create('role_user', function (Blueprint $table) {
            $table->integer('role_id')->unsigned()->onDelete('no action')-
>onUpdate('cascade');
            $table->integer('user_id')->unsigned()->onDelete('no action')-
>onUpdate('cascade');
```

```
'background.jpg',
        ]);

        $contact = 'App\Contact'::create([
            'value' => 'superadmnin@onlineDP.ac.tz', 'category' => 'email',
'person_id' => $person->id,'created_at' => date('Y-m-d H:i:s'), 'updated_at' =>
date('Y-m-d H:i:s'),
        ]);

        #to allow superuser to have login privilege the superuser user is
created with the information as follows
        $user = User::create([
            'role_id' => $role->id, 'person_id' =>$person->id, 'username' =>
'superadmin_01', 'password' => bcrypt($token), 'created_at' => date('Y-m-d
H:i:s'), 'updated_at' => date('Y-m-d H:i:s'),
        ]);

        #the home menu for super user is created
        $menu = Menu::create([
                'user_id' => $user->id,'text' => 'Home', 'href' => '/home',
'parent' => 0, 'icon' => 'fa fa-home', 'flgChildren' => 0,
        ]);
        # the association of the menu and role is established
        DB::table('menu_role')->insert([
            [
                'menu_id' => $menu->id, 'role_id' => $role->id, 'created_at' =>
date('Y-m-d H:i:s'), 'updated_at' => date('Y-m-d H:i:s'),
            ],
        ]);

        #the created user and role are associated here...
        DB::table('role_user')->insert([
            [
                'role_id' => $role->id, 'user_id' => $user->id,'created_at' =>
date('Y-m-d H:i:s'), 'updated_at' => date('Y-m-d H:i:s'),
            ]
        ]);
        $this->down();
    }
    /**
     * Reverse the migrations.
     *
     * @return void
     */
    public function down()
    {
        Schema::dropIfExists('role_user');
    }
}
```

Appendix 9: onlineDP readme file



readme file - Notepad

File Edit Format View Help

ReadMe File

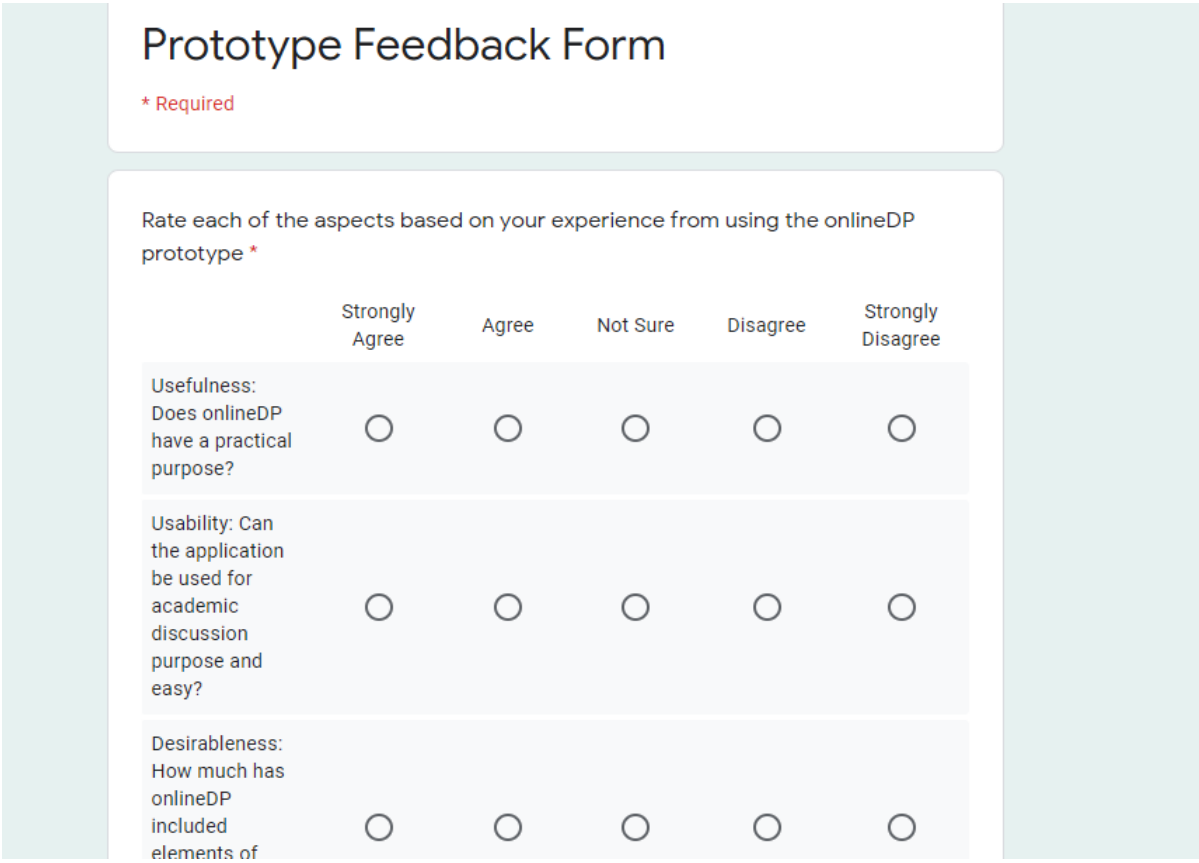
The onlineDP Applicaltion is a web based application that requires internet connection for it to operate. Make sure that you're connected to an internet with good speed.

The following are the configurations details on how to use it.

A. For the user who would like to use the zipped file onlinedp.zip and windows machines
1. Make sure that you have installed the minimum laravel 5.6requirement to your local machine for more details on how to make it visit https://laravel.com/docs/5.6
2. Make sure that you have XAMMP server installed on your Machine the minimum requirement for the application to work should be as

"ApacheFriends XAMPP Version 7.2.7 ######Important! PHP in this package needs the Microsoft Visual C++ 2008 Redistributable package fromhttp://www.microsoft.com/en-us/download/details.aspx?id=5582. Please ensure that the VC++ 2008 runtimelibraries are installed on your system". "+ Apache 2.4.33 + MariaDB 10.1.34 + PHP 7.2.7 (VC15 X86 32bit thread safe) + PEAR + phpMyAdmin 4.8.2 + OpenSSL 1.1.0g + ADOdb 518a" + "Mercury Mail Transport System v4.63 (not included in the portable version) + FileZilla FTP Server 0.9.41" (not included in the portable version) + Webalizer 2.23-04 (not included in the portable version) " + Strawberry Perl 5.16.1.1 Portable + Tomcat 7.0.56 + XAMPP Control Panel Version 3.2.2 by hackattack142 (Great Thanks!!)) See: http://www.apachefriends.org/f/viewtopic.php?f=16&t=46743 "+ XAMPP mailToDisk 1.0
(write emails via PHP on local disk in <xampp>\mailoutput. "Activated in the php.ini as mail default.)
" ---------- * System

Appendix 10: Google form survey tool for user feedback



Prototype Feedback Form

* Required

Rate each of the aspects based on your experience from using the onlineDP prototype *

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
Usefulness: Does onlineDP have a practical purpose?	○	○	○	○	○
Usability: Can the application be used for academic discussion purpose and easy?	○	○	○	○	○
Desirableness: How much has onlineDP included elements of	○	○	○	○	○

Appendix 11: Python codes in Jupyiter notebook

```
#importing necessary libraries for different manipulation of and data, analysis and visualization

%config IPCompleter.greedy=True

%matplotlib inline

import numpy as np

import matplotlib.pyplot as plt

from matplotlib.ticker import MaxNLocator

import pandas as pd

import pandas.tseries as sm

import statistics as stats
```

```
#reading a CSV data set file and making a dataframe df and displaying the records

df=pd.read_csv('Questionnaire_students.csv') #the code which reads the dataset

df
```

```
#Process 1: for this data set some ordinal columns are: INTE_RATE, ODP_RECC, and DISC_COND

#retrieves a specific ordinal column from the data frame

#Replace INTE_RATE with any ordinal column name

dfordinal = df['INTE_RATE']


#actual mean

mean = dfordinal.mean()

print('Actual Mean = ',mean)


#rounded off mean

new_mean = round(dfordinal.mean(),0)
```

Data preprocessing techniques [ordinal data]